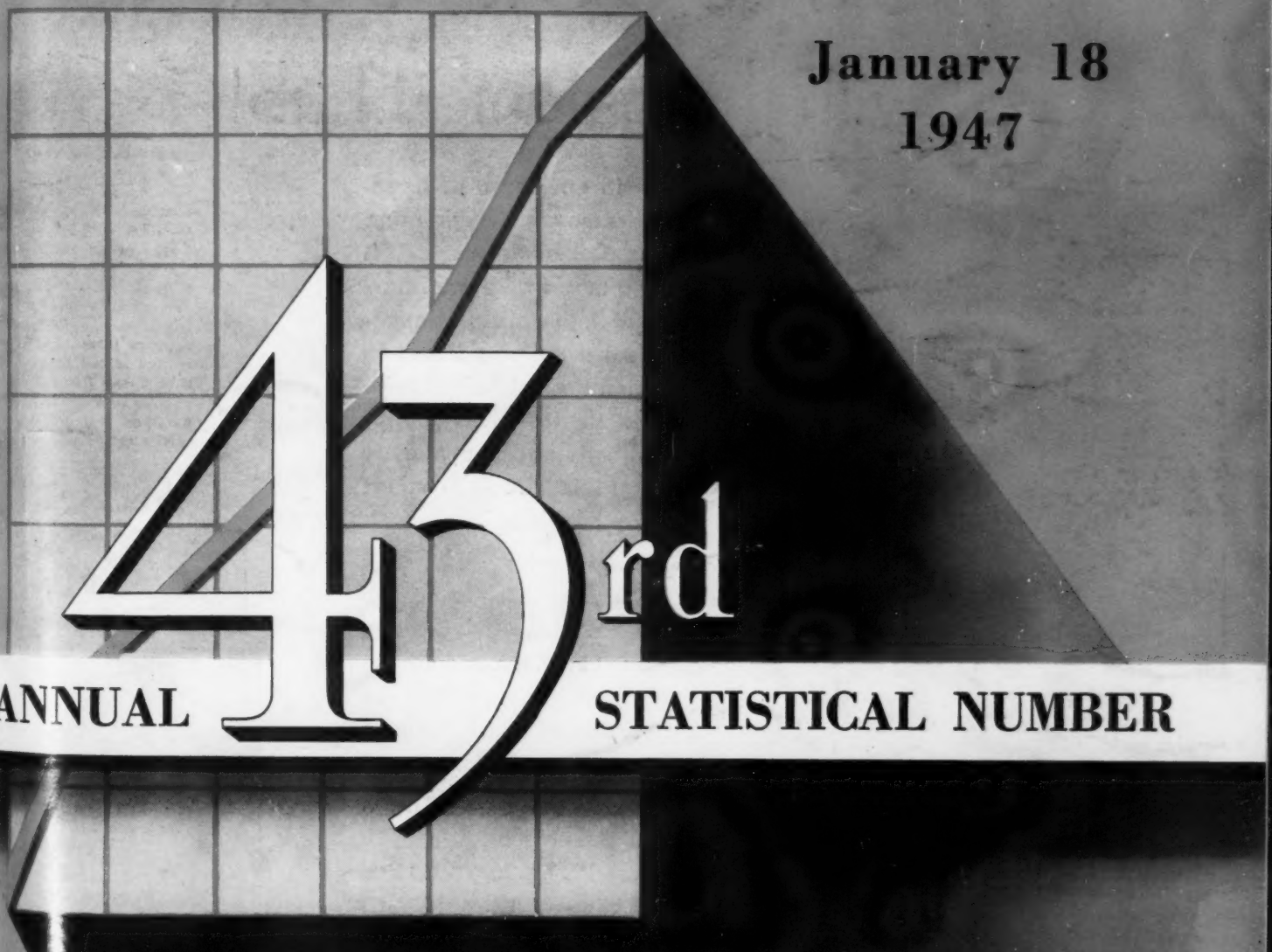
JAN 22 1947

Electrical World

A McGRAW-HILL PUBLICATION



January 18
1947

43rd ANNUAL STATISTICAL NUMBER

This is the

Murray MAGNETIC CIRCUIT BREAKER

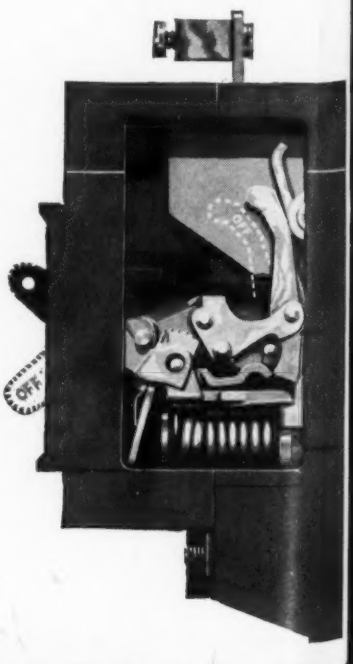
in the RAIN-TIGHT OUTDOOR BOX with the patented hub!

THIS enclosure of deep-drawn construction and patented one-piece top, is designed to be weather-proof. Made of corrosion-resistant metal with baked-on aluminum finish. This rain-tight device gives proper protection to the Murray Magnetic Circuit Breakers mounted within it.

Murray Service Equipment is simplicity itself. Removal of but one screw releases the main cover. Note that the overhanging cover over the breakers, as well as the main cover, are sealable.

Murray Magnetic Circuit Breakers are made in capacities of 10, 15, 20, 25, 35 and 50 amperes, 125 volts A.C. All are suitable for 125/250-volt 3-wire A.C. service.

The use of a magnetic tri... ping mechanism and an ef... cient magnetic blow-out pr... vides an instantaneous circu... interruption in the event of ... short circuit. A precision time... delay device accommodate... the brief overloads normal... encountered, such as motor... starting currents or the high... initial current flow through... tungsten lamps. The charac... teristics of the Murray Mag... netic Circuit Breaker are no... affected by above-normal tem... peratures ordinarily found in... service equipment.



OFFICES IN PRINCIPAL CITIES

METROPOLITAN DEVICE CORPORATION

BROOKLYN 16, NEW YORK

Electrical World

FOUNDED IN 1874 • READ BY ELECTRICAL MEN FOR 72 YEARS

January 18, 1947 **Contents** Vol. 127, No. 3

43rd ANNUAL STATISTICAL NUMBER

Highlights	135	Revenue	152
Trend	136	Customers	154
Outstanding Facts	137	Financial	155
Output	138	Budget	158
Capacity	140	Transmission	160
New Capacity	142	Substations	160
Generator Ratings	146	Rural Lines	161
Maintenance	147	Labor	162
Station Economics	148	Manufacturing	164
Energy Sales	150	REA	166

Editorials ..... 123 and 133

News of the Electrical World 124

Washington Comment 134

HOW 167

Engineering Reference Sheets ..... 172 and 174

New Equipment 194

News About People 208

Manufacturers and Markets 224

Recent Rate Changes 231

Letters to the Editor 236

Index of Advertisements 250

Price of this issue, $1 per copy

LEE H. HILL.....*Editor and Publisher*

DANIEL T. BRAYMER....*Managing Editor*
ARCHER E. KNOWLTON..*Associate Editor*
FRANK R. INNES.....*Associate Editor*
RICHARD N. LARKIN....*Associate Editor*
STANLEY A. TUCKER....*Associate Editor*
RUE M. SHOOP.....*Assistant Editor*
JULIUS C. MEIER..*Manufacturing Editor*
KENNETH K. KOST.....*News Editor*
EDNA M. GLENNON.*Assistant News Editor*
FRANK E. SANFORD.....*Western Editor*
H. S. KNOWLTON....*New England Editor*
WALTER C. HESTON..*Pacific Coast Editor*
D. D. HOGATE....*Mgr. Washington Bureau*
WILLIAM B. WHICHARD
Washington Correspondent

ECONOMICS DEPARTMENT....Dexter M. Keezer, *Director*. William F. Butler, Sanford S. Parker, John D. Wilson.

M. S. MacNAUGHT.....*Manager*
W. W. GAREY.....*Assistant Manager*

DISTRICT MANAGERS . . . E. F. Coffey, New York; N. V. Palmer, Boston; F. P. Coyle, Philadelphia; C. R. Lippold, Cleveland; R. R. Ream, Detroit; W. H. Meneilley, Chicago; J. T. Schaefer, St. Louis.

WORLD NEWS BUREAU...John Chapman, *Director*. Howard Whidden and Frederick Brewster, London; Michael Marsh, Paris; John Christie, Berlin; Frank E. Frank, Prague; Robert Magidoff, Moscow; A. W. Jessup, Shanghai; Joseph VanDenburg, Bombay; Ernest Hediger, Mexico City; Russell F. Anderson, New York.

DOMESTIC NEWS BUREAUS...Atlanta, Chicago, Cleveland, Detroit, San Francisco and Washington. Correspondents in 43 other principal cities.

The contents of this issue are copyrighted and may not be reproduced without the permission of the copyright owners.

ELECTRICAL WORLD Published weekly. Price 35 cents a copy. Publication office 99-129 N. Broadway, Albany 1, N. Y. Allow at least ten days for change of address. Address communications about subscriptions to J. E. Blackburn, Jr., Director of Circulation. **Return Postage Guaranteed.** Subscription rates: In the United States, $6 a year, $9 for two years, $12 for three years. Canada $7 for one year, $11 for two years, $14 for three years (Canadian money at par). Pan-American countries $15 for one year, $25 for two years, $30 for three years. All other countries $20 for one year, $30 for two years, $40 for three years. Please indicate position and company connection on all subscription orders. Entered as second class matter November 16, 1936, at Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in the U. S. A. Contents copyrighted, 1946, by McGraw-Hill Publishing Co, Inc. All Rights Reserved. Branch Offices: 520 North Michigan Avenue, Chicago 11, Ill.; 68 Post Street, San Francisco 4; Aldwych House, Aldwych, London, W. C. 2; Atlanta, Ga.; Boston, Cleveland, Detroit, Los Angeles, Philadelphia, Pittsburgh, St. Louis, Washington.

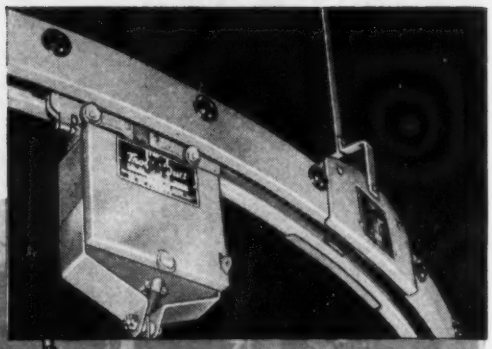
McGRAW-HILL PUBLISHING CO., INC.
JAMES H. McGRAW
Founder and Honorary Chairman

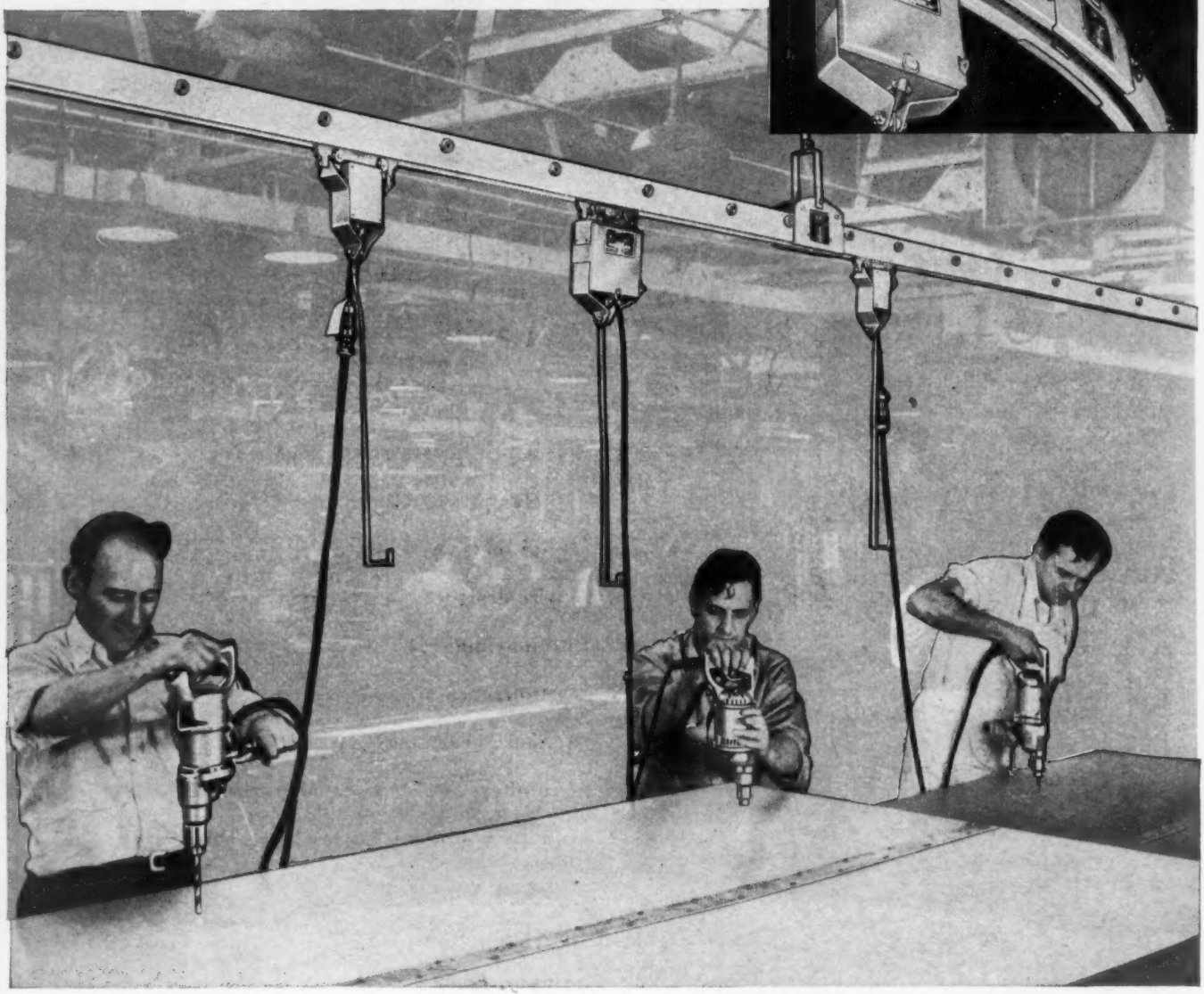
Publication Office.....99-129 N. Broadway, Albany 1, N. Y.
Editorial and Executive Offices.....330 West 42nd St., New York 18, N. Y.
JAMES H. McGRAW, JR.....President
CURTIS W. McGRAW.....Senior Vice-President and Treasurer
JOSEPH A. GERARDI.....Secretary
NELSON BOND.....Director of Advertising
EUGENE DUFFIELD.....Editorial Assistant to the President
J. E. BLACKBURN, JR.....Director of Circulation

Member A.B.P. Member A.B.C.

Cable Address McGRAW-HILL, New York

Power takes a trolley ride*





POWER travels with the job when your cranes, hoists and portable tools are electrified by BullDog Industrial Trol-E-Duct.

It takes only an eight-ounce pull to put power at a workman's elbow—with no danger from entangling extension cords and no possibility of accidental contact with "live" wires.

The moving trolleys, collecting current from bus bars enclosed in a rigid steel duct, provide a source of power that is safe, convenient and economical.

Slotted over its entire length, Industrial Trol-E-Duct provides a continuous electrical outlet that completely eliminates the need of rewiring or adding new fixed outlets. Maintenance costs are minimized, because all current-carrying bus bars are firmly supported on the duct casing and long extension cords are unnecessary.

Your plant can have all the advantages of this modern electrical distribution system if you consult a BullDog Field Engineer right away. He'll give you full technical information and show you a BullDog installation near your own plant. Or, if you'd like descriptive literature, write BullDog direct.

***With BullDog Industrial Trol-E-Duct**

ADEQUATE WIRING SERVES AND SAVES

BULLDOG

ELECTRIC PRODUCTS COMPANY

BULLDOG manufactures Vacu-Break Safety Switches — SafToFuse Panelboards — Superba and Rocker Type Lighting Panels — Switchboards — Circuit Master Breakers — "Lo-X" Feeder BUStribution DUCT — "Plug-in" Type BUStribution DUCT—Universal Trol-E-Duct for flexible lighting—Industrial Trol-E-Duct for portable tools, cranes, hoists.

Detroit 32, Michigan. Field Offices In All Principal Cities. In Canada: BullDog Electric Products of Canada, Ltd., Toronto.

Kerite Splicing Compound Tape

PERMANENTLY HIGH DIELECTRIC STRENGTH

Like conductors protected by Kerite insulation, joints made with Kerite Splicing Compound Tape have a successful service history of over fifty years under a wide variety of operating conditions.

Kerite Splicing Compound Tape does not require heat treatment after application.

Available in ¾-inch and 1½-inch widths. Shipment from stock in moderate quantities.

THE KERITE COMPANY

NEW YORK • CHICAGO • SAN FRANCISCO • LOS ANGELES

PIONEERS IN CABLE ENGINEERING

THE CLOSED SHOP

Key to Labor Monopoly

IF THE PEOPLE of the United States are to loosen the monopoly control now exercised by some segments of union labor and recapture the power to control their own economic and political destiny, they must come to grips with the problem of the closed shop. A satisfactory solution of that problem is as vital to the interests of the wage earner, who should be fully protected in his right to organize and bargain collectively through representatives of his own choosing, as it is vital to the interests of the nation as a whole.

By the closed shop, which unfortunately is a term that seems to shed more heat than light, I mean any shop in which the worker must make his peace with a union in order to have a job. There are approximately 13½ million union members in the United States. Of these about 10 million are governed by arrangements calling for "closed" shops, union shops, maintenance of membership provisions and similar devices which make good standing in a union a condition to holding a job.

Such arrangements raise serious issues about what is commonly presumed to be the basic American right to work. Also, closed shop arrangements lie at the root of the dominant economic power now exercised by some labor leaders.

The problem of reducing the power of these labor leaders to proportions that make it safe for democracy is the age-old problem of monopoly. In an earlier era this problem was created largely by businessmen who sought to escape the restraints of competition by combinations or agreements to control prices and production. Such efforts are still attempted and must be curbed by law.

Union Labor Monopoly

But, after more than a decade during which a monopoly position for organized labor has been aggressively promoted by the federal government, the major monopolists today are those labor leaders who wield the power of enormous nationwide unions. About 90% of the soft coal miners do the bidding of John L. Lewis. A like percentage of the auto workers are represented by the United Automobile Workers of the C. I. O. About 80% of the production workers in steel are members of the United Steel Workers, C. I. O. No single corporation has more than a fraction of the economic power that is concentrated in these unions. And if corporations were to combine their power to cope effectively with that of these union monopolies they would unquestionably find themselves charged with violating the federal antitrust laws.

In its national sweep, the monopoly power of unions rests largely on their exemption from the federal antitrust laws. My previous editorial in this series (the 53rd) discussed the desirability of removing that exemption. The local roots of this monopoly power are often embedded in closed shop arrangements.

Closed Shop in Coal

An illuminating case in point is provided by the United Mine Workers, whose leader John L. Lewis has graciously given the country a 3½-month reprieve from "the hysteria and frenzy of an economic crisis," as he himself termed it. During that latest crisis the dispatches from the soft coal fields reported that the miners were standing behind John L. Lewis almost to a man. And the implication usually was that the driving forces of the strike were loyalty to Lewis and the prospect of economic gain.

Underlying that performance, however, and basic to it was an agreement in the soft coal fields providing that "as a condition of employment all employees shall be members of the United Mine Workers." Hence to hold a job in 90% of the soft coal industry which is governed by contracts with the United Mine Workers, a miner must not offend the union. To avoid offense the union member must even be careful in criticising what his union

does. *Suspension from the union for six months, and hence from the right to hold a job,* is the penalty imposed by the United Mine Workers constitution for circulating a statement "wrongfully condemning any decision rendered by any officer of the organization."

The willingness of the miners to follow Lewis until the country froze over was not, of course, exclusively a product of the agreement limiting jobs in the coal fields to union members of good standing. Some of it originated in bad handling of employee relations in the coal fields in years gone by. But the fact remains that Lewis' soft coal monopoly has as one of its principal foundations an agreement which gives the United Mine Workers a job-or-no-job hold on 90% of the soft coal miners.

In its extreme form, the closed shop not only makes union membership a condition of employment but narrowly limits the numbers admitted to union membership and hence to the opportunity to work. In this way it is used to enforce restriction of output and working rules which would never stand up under free competition.

Fair Dealing

The closed shop raises major issues of personal freedom and fair dealing between individuals. As matters now stand, closed shop agreements require employers to discharge workers who lose their good standing in the unions involved. At the same time they frequently impose no requirement on unions to grant membership to law abiding and technically qualified persons. Many unions with closed shop agreements refuse to grant membership on the basis of competence. Thus, qualified workers are denied a fair chance to hold a job.

In its dealings with the closed shop issue the federal government has been pushed into a self-contradictory position. The National Labor Relations Act (the Wagner Act) provides, and properly, that "employees shall have the right . . . to bargain collectively through representatives of their own choosing." In furtherance of that basic proposition, the Wagner Act also provides that "It shall be an unfair labor practice for an employer . . . by discrimination in regard to hire or tenure of employment to encourage or discourage membership in any labor organization . . ." Standing alone, the provision would clearly outlaw the closed shop.

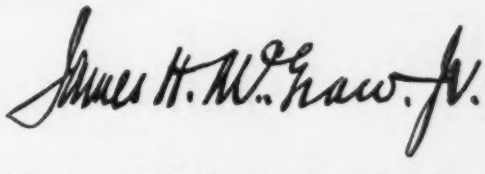
But then, to favor the closed shop, the Wagner Act turns right around and provides that "nothing in this Act . . . shall preclude an employer from making an agreement with a labor organization . . . to require, as a condition of employment, membership therein," provided that certain conditions of representation are fulfilled. This places the National Labor Relations Board in the impossible position of trying to administer a law which simultaneously points in opposite directions.

In successfully contending that there should be no closed shop arrangements on the railroads, the late Joseph Eastman, Federal Co-ordinator of Transportation, said, "If genuine freedom of choice is to be the basis of labor relations under the Railway Labor Act, as it should be, then the yellow dog contract and his corollary, the closed shop . . . have no place in the picture." The so-called yellow dog contract, which requires a worker to agree not to join a union as a condition of employment, has long since been outlawed.

At one time the closed shop was defended as a protective device for feeble young unions struggling against predatory employers. But a mere glance over the current economic scene discloses that the time when that argument was supported by the facts is past. Now it is the labor leaders who frequently exercise decisive economic power.

At elections in November three more states, Arizona, Nebraska and South Dakota, passed constitutional amendments outlawing the closed shop. In doing so, they joined six other states, which, in one way or another, have restricted the closed shop. The South Dakota amendment presented the basic issue created by the closed shop in simple and direct terms when it declared that "The right of persons to work shall not be denied or abridged on account of membership or nonmembership in any labor union, or labor organization."

That issue must be squarely faced by the new Congress if its first order of business, the labor crisis, is to be resolved.



President McGraw-Hill Publishing Company, Inc.

THIS IS THE 54TH OF A SERIES

EVERYTHING IN WIRING POINTS to—

NATIONAL ELECTRIC—

the COMPLETE *line of* Raceways, Wire, Cables and Fittings

Sold nationally through electrical wholesalers.

National Electric Products Corporation
Pittsburgh 30, Pa.

Electrical World

JANUARY 18, 1947

The Question of the Statistics

PROMISE of good or of ill, as time will tell, is contained in this number of ELECTRICAL WORLD. It is everywhere implicit in the annual statistics of the electrical industry, presented in this magazine for the 43rd successive year.

Since the war, use of electricity by large industrials has declined, but less than was expected. Coincidentally, use in homes and in commercial places and on farms has increased, but more than was expected. In the last half of 1946, weekly outputs of electricity topped the highs of the war years. The net result has been that in 1946 total sale of electricity was within 3.5 percent of 1944, the peak year of war production.

New customers connected to electricity supply lines in 1946 were more than in any year of the industry's history.

More customers demanding more electricity add up to the biggest program of construction in 1947 that the electric utilities have ever faced; the money estimate of it is over $1,300,000,000.

Here, stated in the simplest terms, are the factors that portend the promise of the statistics to be for good. These factors extend outward in a vast network of effect that touches every element in the national economy. Through that network the money to be expended in electricity supply system construction will be multiplied many times and thus become a major contributor to the prosperity of the nation.

From their successful performance during the war period the electric utilities emerged in urgent need of additional production and distribution capacity. Since the war that need has not been met. It remains unfilled and it becomes more pressing each day as more people use more electricity.

Here, again in simplest terms, is the factor that may portend the promise of the statistics to be for ill.

As the construction plans of the electric utilities affect national conditions, so are they affected by them.

If, again in 1947 as in 1946, electrical goods production is hindered and hampered to large extent by strikes and other turmoils, the ability of the electric utilities to meet the demands of users of their service will again be set back. And, quite possibly, such a setback will force the first entry of failure on the electric utilities' hitherto unmarred record of complete response to service demands. And that failure will be reflected and magnified throughout all industry.

What will it be, for good or for ill, this promise of the statistics?

The promise will be for good if production be allowed to accelerate from the rate set in the second half of 1946. It will be for ill if the masters of union labor insist again on higher money wages and call their members out on strikes to gain this end. Then may follow curtailments of service in places where capacity reserve margins are narrow now.

★ ★ NEWS OF THE

House Group Budget Scrutiny Will Begin with Power Items

Closed Hearings on Fiscal 1948 Appropriations Expected in Order to Speed Bills—Reductions in Original Budget Figures Seem Certain under New Committee Organization

HUGE FUNDS for federal power operations during fiscal 1948 will be among the first budgetary items inspected by the 80th Congress as the House begins hearings on five major appropriations bills on January 20.

Three of the bills, those for the War, Interior, and Agriculture Departments, contain the principal appropriations expected to be advanced during the fiscal year for power construction, either directly by federal agencies or through federal loans.

Though Appropriations Committee Chairman John Taber, New York Republican, had made no announcement regarding the status of the hearings as this is written, it was believed that consideration of all five bills would be conducted behind closed doors. The Congressional Reorganization Act provides for open or public hearings on appropriations measures, but it allows closed meetings on demand of a majority of the committee. Because of the need for clearing both Houses of all appropriations bills before the end of the current fiscal year, it is expected that the committee will ban open hearings in order to avoid delays inherent in such sessions.

House Expected To Slash Budget

Reductions of power items in both the Interior and Agriculture REA appropriations are expected to result from House hearings on these measures. Even under Democratic control, the House committee last spring slashed power funds from Interior appropriations, notably for construction of federal transmission lines in California's Central Valley and lines linking dams operated by the Southwestern Power Administration.

Bureau of Reclamation requests for $20,000,000 for Central Valley construction during fiscal 1948, as approved by the president and the Budget Bureau, again include funds for new transmission lines. Last year, after spirited debates in both the House and Senate, Central Valley project funds for fiscal 1947 were reduced from the full budget estimate of $25,000,000 to $12,685,622, but allotments for three controversial transmission lines were retained.

Of the $7,500,000 appropriated for SPA construction and acquisitions by Congress last spring, $1,352,415 was earmarked for purchase of a portion of the Ark-La transmission line from Markham Ferry, Okla., to Nimrod, Ark. The 1948 budget estimate for SPA contains an additional $2,000,000 for acquisition of the Ark-La line, apparently in its entirety, and substation. No part of the line yet has been purchased by SPA from the REA-financed cooperative which owns the property.

Already reported to have experienced a $10,000,000 cut in its own budgetary estimates at the hands of the Budget Bureau, Bonneville Power Administration is another Interior agency expected to feel slashes of the House committee's paring knife. Key members of the subcommittee in charge of Interior appropriations, Republicans Robert F. Jones of Ohio and Ben F. Jensen of Iowa, during the last session were outspoken critics of Interior power spending in general and Bonneville operations in particular.

Chairman Taber himself has announced that he is sharpening the economy axe for the Rural Electrification Administration, which is going in for a direct appropriation of $25,000,000 for lending funds and an authorization to borrow $225,000,000 from Reconstruction Finance Corporation for the same purpose.

REA also fears a reduction of its budgetary estimate of $5,600,000 for administrative expenses.

The Budget Bureau, after practically abandoning its expenditure ceilings on public works construction, has instructed both the Reclamation Bureau and the Army Engineers that they can carry forward only those projects already under construction or those for which some funds were appropriated prior to fiscal 1948. No entirely new reclamation, flood control or rivers and harbors projects may be started during the coming fiscal year under this ruling which can be changed later.

THE BOSS GETS THANKED—Vice-President R. E. Ritchie, Arkansas Power & Light Co., is presented with a gold wrist watch by Mrs. Frances Kirkwood, cashier at Earle, Ark. The gift was a token of appreciation of the employees of the company's Eastern Division for Mr. Ritchie's efforts in their behalf in 1946

FPC Dismisses Application of Utility for Clark Hill Site

Commission Sidesteps Private vs. Public Development Fight by Merely Ruling That It Had Already Approved Engineers to Handle Project—Jurisdictional Problem Not Taken Up

SIDESTEPPING the controversial issue of private vs. public development of water resources, the Federal Power Commission this week dismissed the application of the Savannah River Electric Co. to construct the multi-purpose Clark Hill project on Georgia's Savannah River.

The dismissal order also shed little light on the commission's viewpoint as to its jurisdictional status in this initial case involving a private company's effort to take over a project started by a federal agency. FPC simply found that it had previously—in 1939 and 1944—recommended federal development of Clark Hill; that the Army Engineers, as directed by Congress, were carrying forward the project "under the usual procedure;" and that the commission would not entertain the application filed by Savannah River Electric last August.

The commission pointed out that it had endorsed federal development of Clark Hill in March, 1939, and had approved plans of the Engineers for the project in May, 1944. These recommendations were considered by Congress when it passed the Flood Control Act of 1944, which authorized, among other projects, the construction of the Clark Hill reservoir.

Public Interest Not Considered

The order did not deal with claims of the company that the public interests best would be served by private development through saving the federal government the construction cost of the project and other economic considerations. But the commission specifically rejected the company's claim that construction of Clark Hill had been delayed, if not halted, in the face of a growing power shortage in Georgia and neighboring states.

At the hearing held by FPC in Atlanta last October, the order noted, evidence was introduced indicating that ceilings imposed last August by the President on public works spending had halted "all flood control projects on which actual construction had not started." However, there was further evidence that the Clark Hill project would "go forward under the usual procedure of appropriating funds from year to year."

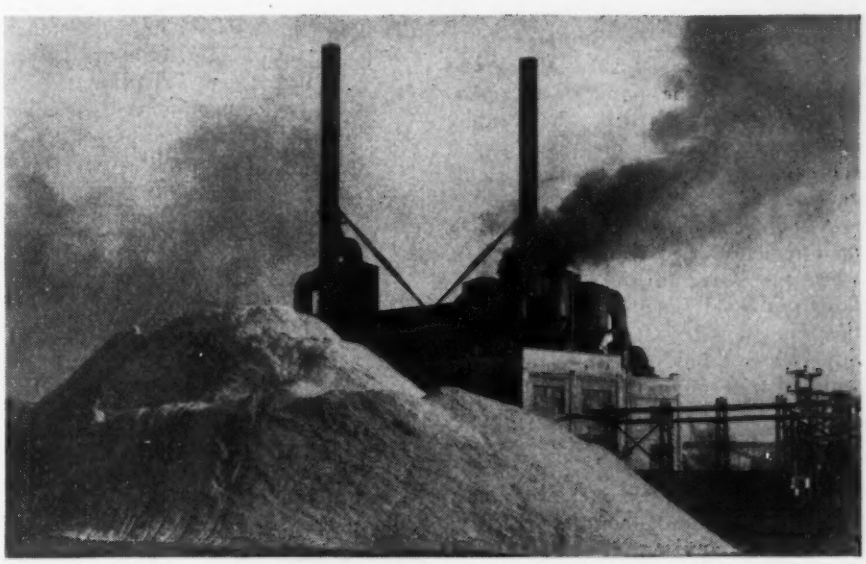
The commission found that Congress, after authorizing construction by the Engineers in 1944, had appropriated $5,500,000 for construction of Clark Hill. Of this amount, "$1,021,000 have been expended and $991,000 committed on outstanding design and construction contracts."

This finding, incidentally, clears the Clark Hill project under the latest Budget Bureau ruling which permits continued construction of flood control work for which funds already have been appropriated.

The commission's order emphasized that the Atlanta hearing was conducted for the purpose of obtaining evidence "on the question of the commission's authority under the Federal Power Act to entertain the application for license." However, the order provides no specific finding on this jurisdictional question.

The Atlanta hearing produced considerable testimony both in opposition and favorable to the application of Savannah River Electric, a subsidiary of the Georgia Power Co. (ELECTRICAL WORLD, November 9, Page 109). The company had proposed to build the project substantially in accordance with plans and specifications drawn up by the Engineers, for which the Congress authorized an expenditure of $35,300,000. The company also agreed to pass on the benefits of the energy produced to public bodies and cooperatives, as provided by flood control laws.

The commission's rejection of the Savannah River Electric application is expected to be reflected in its forthcoming disposition of an Arkansas Power & Light Co. bid to erect the power plant at the Army's Bull Shoals project on the White River in Arkansas.



YELLOW "COAL"—Free from all worries of coal strikes and shortages are the officials of the Northwestern Electric Co. whose standby steam plants burn fuel oil or as in the case of the Lincoln plant at Portland, Ore., shown here, hogged fuel, which is sawdust and small bits of wood from lumber mills in the area

Court and Congress May Clarify Foremen's Unions

Wagner Act Change to Eliminate Supervisory Personnel Likely—Supreme Court May Act First

Both Congress and the Supreme Court took steps recently which may bring early clarification of the collective bargaining status of foremen.

Congressional groups pondered amending the Wagner Act by specifically eliminating supervisory personnel from its coverage. Meanwhile, the Supreme Court heard arguments on the National Labor Relations Board's interpretation of the act regarding foremen.

Any solution of the foremen's issue will directly affect the existing contract between the Virginia Electric & Power Co. and the International Brotherhood of Electrical Workers unit which is bargaining agent for 180 VEPCO foremen. To avoid a threatened strike last October, the utility recognized the foremen's union for one year. Its officials announced that renewal hinges upon court determination of the validity of such bargaining under the Wagner Act.

Utility Will not Bargain

An independent union, certified by NLRB as bargaining agent for foremen of the Potomac Electric Power Co., has brought unfair labor practice charges against the company for refusal to bargain. The company announced that it refused to recognize the unit until clarification of the foremen issue by the courts. The case is unsettled.

Right of foremen to compel bargaining with them as members of an independent union admitting only foremen was argued before the Supreme Court last week in the Packard Motor Car case, involving the Foremen's Association of America. NLRB, whose ruling favoring the union is contested, joined the company in asking Supreme Court review.

A more far-reaching NLRB decision on foremen started through the courts when the board directed the Jones & Laughlin Steel Corp. to bargain with the United Clerical, Technical and Supervisory Employees Union, affiliated with District 50 of the United Mine Workers, A.F.L., on behalf of supervisors at four captive coal mines.

Since the U.M.W. also represents the production workers in these mines, the issue here is whether the NLRB is correct in requiring an employer to deal with a union of his supervisors when it bargains for workers they supervise.

NLRB members Paul M. Herzog and John M. Houston, who voted the majority decision, explained they only administer the Wagner Act, implying that Congress should change the law if it intended any other result. Gist of their contention is that NLRB has no discretion but to recognize whatever union employees select, so long as it is not company dominated.

It is possible that action by Congress amending the Wagner Act regarding foremen may render meaningless any decision by the Supreme Court. But Congress may withhold such revision if the court holds that foremen are not covered by the law.

•

October Electric Energy Sales Rise 12.2 Percent

Sales of electric energy to ultimate customers in October, 1946, totaled 16,721,294,000 kw.-hr., compared with 14,902,206,000 kw.-hr. in October, 1945, an increase of 12.2 percent, according to the report issued by the Edison Electric Institute.

Classification of Sales, October, 1946 and Change from 1945

Kilowatt-hour sales October	Million Kw.-Hr. 1946	1945	% Change
Residential or domestic	3,130	2,789	+12.2
Rural (Distinct rural rates)	410	390	+ 5.1
Commercial or industrial			
Small light & power	2,821	2,509	+12.4
Large light & power	9,064	7,826	+15.8
Street & highway lighting	206	197	+ 5.0
Other public authorities	471	555	−15.2
Railways & railroads			
Street & interurban	351	371	− 5.2
Electrified steam railroads	221	217	+ 1.5
Interdepartmental	47	48	− 1.4
Total to ult. customers	16,721	14,902	+12.2

Revenue from ultimate customers amounted to $292,587,200 in October, compared with $271,413,100 in October, 1945, an increase of 7.8 percent.

For the twelve months ended October 31, 1946, the average use per customer advanced to 1,312 kw.-hr. from 1,208 kw.-hr. for the preceding year, an increase of 8.6 percent; the average annual bill to $42.64 from $41.56, an increase of 2.6 percent; revenue per kilowatt-hour dropped from 3.44 cents per kilowatt-hour to 3.25 cents per kilowatt-hour, a decrease of 5.5 percent.

•

Municipal Plant Rejected

A proposed $659,000 bond issue to finance the construction of a municipal power plant was defeated by voters of Washington, Mo., by over a 3 to 1 margin at a recent election. The city is now served by the Union Electric Co. of Missouri.

Consolidated Edison Sued by U.W.U. for $20,000,000

Portal-to-portal pay suits, which have involved many of the nation's largest manufacturers, have now made their appearance in the utility industry. Local 7, Utility Workers Union of America, C.I.O., has brought suit in Federal Court in New York against the Consolidated Edison Co. for $10,000,000 plus an equal amount as liquidated damages.

A similar joint suit was brought by the same union against two Consolidated subsidiaries, Yonkers Electric Light & Power Co. and the Westchester Lighting Co., for $1,000,000 plus an equal sum for liquidated damages.

The union charges violations of the Fair Labor Standards Act with respect to overtime payments from October 24, 1938, to date.

National officers of the union in New York said that similar suits had been filed by other locals in various sections of the country.

In Washington, a spokesman for Daniel W. Tracy, president of the International Brotherhood of Electrical Workers, A.F.L., said that his union feels that most of the portal-to-portal pay suits are premature and unjustified. Where I.B.E.W. has contracts, it will abide by them. Although the national office can't prevent individual workers from filing suits, it will take steps to discourage any local unions from taking such action.

•

14 Strikers Found Guilty by Jury of Riotous Acts

Fourteen striking employees of the Illinois Rural Electric Co., Winchester, Ill., were found guilty last week by a Greene County Court jury of riotous acts against a construction crew of the co-op near Athensville last November 14 (ELECTRICAL WORLD, December 7, 1946, Page 91). The jury reached its verdict after three hours' deliberation.

Sentence was withheld by Judge Julian Hutchens who gave the defense ten days to ask for a new trial. Maximum sentence is six months in jail and $200 fine for each defendant. The strikers are members of a local of the International Brotherhood of Electrical Workers, A.F.L.

•

Distribution System Sold

New Jersey Power & Light Co., Dover, has acquired the municipal distribution system of Ogdensburg, N. J., for $30,500.

NEMA Calls upon Congress to Bar Secondary Boycotts

President R. S. Edwards in New York Interview Describes Effects of Union Restrictions upon Industry—U.S. Supreme Court Has Ruled Firms Can Get Relief Only from Congress

THE National Electrical Manufacturers Association, through its president, R. Stafford Edwards, called on Congress last week to outlaw all forms of secondary boycotts of electrical products by labor unions as being in restraint of trade. Mr. Edwards asserted that the public and the industry have been "victimized" for more than twelve years. He estimated the boycott affects yearly "at least $500,000,000 worth of electrical products."

Mr. Edwards endorsed the stand taken by President Truman's annual message which held that secondary boycotts are an "unjustifiable practice in certain applications." Indicating the association's contention that the President, however, did not go far enough, he continued:

"The industry calls upon Congress to outlaw all forms of the secondary boycott."

"The organized secondary boycott is the same type of economic force as mass picketing and sit-down strikes," Mr. Edwards said. "It takes from the public the right to make its own decisions on the merits of a dispute and, indeed, even takes that same right from the group of employees directly concerned.

Boycott Monopolistic Weapon

"The right to strike and other tremendous powers guaranteed labor by the Wagner Act, actually make any boycott a punitive, coercive, uneconomic and monopolistic weapon with which any organized body may ride roughshod over the rights of the public, employers, and, in many cases, over another segment of labor itself. What has existed in the electrical industry for twelve years is nothing more or less than a carefully organized and executed boycott by one union to maintain a complete nation-wide monopoly on the manufacture, distribution, transportation, and installation of electrical products."

He pointed out that under the decision of the Supreme Court in the case of Allen-Bradley Co. vs. Local No. 3, I.B.E.W. (325 U. S. 797), the I.B.E.W. legally can and by boycott is restraining and destroying interstate trade and commerce. "Further," he added, "the Court not only recognized that these labor union activities substantially restrain trade but that, under the Clayton Act, in the light of the Norris-La Guardia Act, labor, acting alone, is exempt entirely from anti-trust laws. The Supreme Court in the Bradley case specifically casts responsibility for this situation on Congress. All we, as industry spokesmen, are now doing is following the chief executive's lead in calling this to the attention of Congress by requesting that legislative body to go all the way."

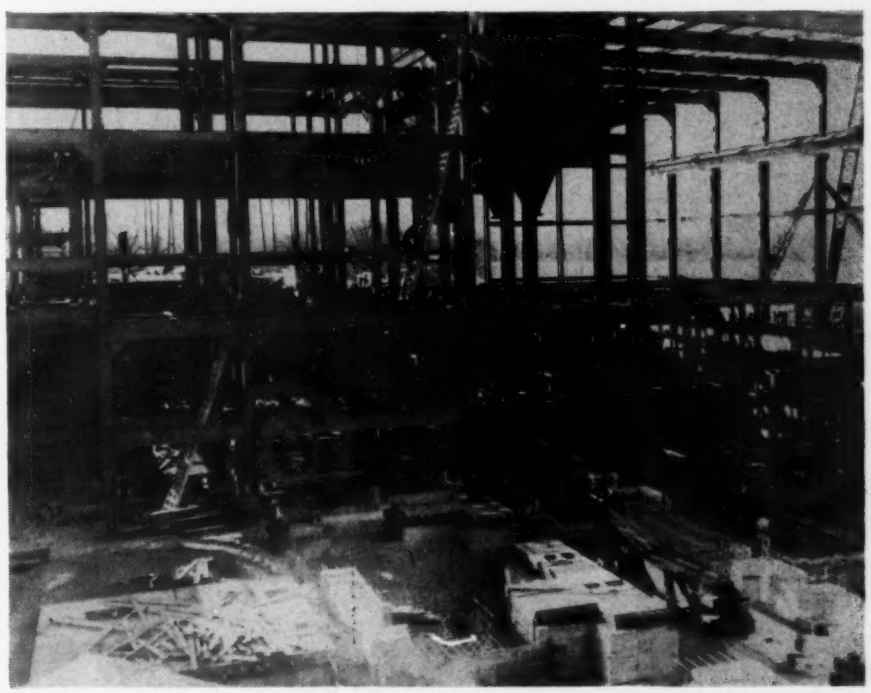
The specific part of the Court ruling to which the NEMA president referred was that paragraph which states;

"Our holding means that the same labor union activities may or may not be in violation of the Sherman Act, dependent upon whether the union acts alone or in combination with business groups. This, it is argued, brings about a wholly undesirable result—one which leaves labor unions free to engage in conduct which restrains trade. But the desirability of such an exemption of labor unions is a question for the determination of Congress."

Revealing effects of the secondary boycott upon manufacturers, Mr. Edwards told of one concern that was nearly put out of business; revealing effects upon customers, he cited several cases in which the cost of equipment was increased from 10 to almost 300 percent. One company which felt the full impact of the practice, the Neon Products Co., Lima, Ohio, had an NLRB certified contract with a C.I.O. local. Contractors' A.F.L. electricians refused to hang the Neon Products' signs. Relief was unavailable and the company has "suffered terrifically as a result."

Mr. Edwards cited a case in which Westinghouse Electric Corp. bid $56,000 for panelboards and switchboards for a low-cost housing project in New York City. The company was informed "it could not have the job at any price, because the product did not bear the union label." The equipment was supplied by a local manufacturer for $110,934.

No case better shows the need for corrective legislation than that of the Lakeshore Electric Manufacturing Corp., Mr. Edwards said. Here the



PLACE FOR TWO UNITS—At the Meredosia plant of the Central Illinois Public Service Co., practically all the steel work for the first 50,000-kw. unit is in place, and the foundations (foreground) for the second unit of the same size are practically complete. The first unit is to be ready in September

C.I.O. defeated the A.F.L. for bargaining rights. Thereafter, nearly all Lakeshore's customers (most of them contractors) withdrew their business since their own employees were members of A.F.L.

Faced with the loss of its business, the company refused to bargain collectively with the C.I.O. union, defending its refusal on the ground that the C.I.O. organizer had represented to the employees that membership in the union would not affect the business of the company nor interfere with jobs.

The trial examiner noted that none of the witnesses had testified directly to the existence of any boycott against Lakeshore, but he found that "such a boycott actually exists." The company was, however, ordered to cease and desist from refusing to bargain collectively with the C.I.O. union and was directed to bargain collectively with it.

Summarizing the effects of this case, Mr. Edwards held:

1. There is no way in which a manufacturer can save his business from the effects of a secondary boycott by members of a defeated union without violating the National Labor Relations Act.

2. He cannot encourage his employees to join the I.B.E.W.

3. He cannot lawfully refuse to bargain with the C.I.O. union, yet if he does bargain and contract with the C.I.O. union, his business is imperiled by the I.B.E.W. boycott.

•

Equipment Orders Placed for 2 Reclamation Plants

Three contracts, totaling $1,328,942, for hydroelectric power equipment were awarded recently by the Bureau of Reclamation. The contracts call for the delivery of four turbines and four generators to be installed at the Estes Park and Marys Lake power plants on the Big Thompson River in Colorado.

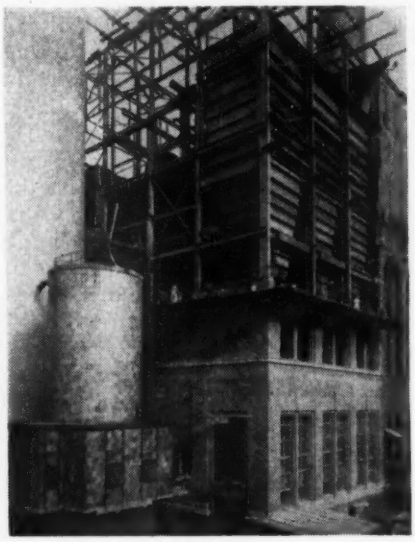
Allis-Chalmers Manufacturing Co. received a $537,592 contract to supply three vertical-shaft, 21,000-hp. turbines for the Estes Park plant. Three 3-phase, vertical-shaft generators of 15,000-kw. capacity for the same plant and an 8,100-kw. generator for Marys Lake will be built by the General Electric Co. under a $626,746 contract. A $164,604 contract for an 11,300-hp. turbine for the Marys Lake plant was awarded to the Newport News Shipbuilding & Dry Dock Co., Newport News, Va.

Terms of the contracts specify shipment of the Marys Lake turbine and generator within approximately 16 months and delivery of the Estes Park plant equipment from 19 to 23 months.

N. England Power System Construction Progresses

Construction work on the New England Power System, while handicapped by material shortages, has advanced substantially in recent months. At the Manchester Street generating station of the Narragansett Electric Co., Providence, R. I., a new 1,200-psi., 40,000-kw. addition is in progress. The unit should go on the line this year.

The above construction is associated with the installation of a second 115-kv. transmission circuit from the system



UNDERWAY—Construction work advances at the Manchester Street station of the Narragansett Electric Co. where a 40,000-kw. unit is being installed

operating center at Millbury, Mass., to Providence, which went into service early in December. This new circuit is about 30 miles long and includes about 28 miles of the New England Power System's "Polarm" overhead construction, utilizing (4/0) copper for power conductors and a 3/8-in. galvanized common steel ground wire. The balance of the line is of oil-filled cable duplicating an original circuit of this type which runs between the Narragansett company's Admiral Street substation and the so-called Franklin Square substation terminal adjacent to the Manchester Street station.

In the North Shore district near Boston a second underground cable operating at 23 kv. has recently been installed between Beverly and Gloucester. This is mainly of the buried type, with 250,000-cir. mil conductors. It strengthens supply facilities in an important residential area, including industrial loads, and when combined with local distribution facilities at Gloucester insures better service and further tie-in with the Eastern Massachusetts Electric System and its interconnections with the important New England Power transmission center at Tewksbury, Mass., and its related sources of bulk energy delivery.

A counterpoise installation is under way between Bellows Falls, Vt., and Pratt's Junction, Mass.; about 75 miles of 3/8-in. galvanized steel cable is being laid in this project.

Recently the System's principal meter laboratory was transferred from Providence to Worcester to take advantage of a more central location. As a result of about five years' successful experience with a cooperative industrial electric heating laboratory supported by utilities for promotional and commercial research at Boston, the New England Power System has established a laboratory of its own in Worcester, emphasizing facilities in the infrared and high-frequency heating fields, and situated in the Faraday Street building of the Worcester County Electric Co.

•

New Bull Shoals Bids Will Be Sought by Engineers

All bids for the construction of the Bull Shoals dam, which is to be erected on the White River in Arkansas, have been rejected by the Army Engineers, and the project will be readvertised in the near future.

Last August, the White-River Constructors, Houston, Tex., a seven-firm combine, was awarded a contract on its low bid of $24,263,935. The contract was never signed because of President Truman's drive for economy. At a recent conference, all seven firms expressed "strong opposition" to performing the work under the terms of the July bid.

•

P.U.D. Raises Wages

Electrical workers are granted increases ranging from 2 to 9 cents an hour in an agreement at Vancouver, Wash., between the Clark County P.U.D. and Local B-125 of the I.B.E.W. The increases became effective Jan. 1.

•

Fourth Unit Planned

Union Electric Co. of Missouri will add a fourth 80,000-kw. unit to its Venice, Ill., steam plant where a third unit is scheduled for completion late in 1947. When the fourth unit is installed, the system capability will be 980,000 kw.

Dealing with Organized Labor Major Problem for REA Co-ops

Long-Working Farmers Have Little Sympathy for Demands of Electrical Workers for Standard Wages and Hours—Strike Frequency Increases as Men Affiliate with Unions

DEALING with organized labor, traditionally a distasteful task for the American farmer, has become a major problem for electric cooperatives financed by the Rural Electrification Administration.

Strikes concerned most REA co-ops only indirectly before World War II when deliveries of power equipment and, occassionally, line-building crews were tied up. In the past five years, however, more and more co-op employees have demanded union wages and working conditions and have staged at least a dozen walk-outs to get them.

Perhaps the most serious cooperative-labor dispute was the three-month-old strike of linemen of the Illinois Rural Electric Co. of Winchester, Ill. (ELECTRICAL WORLD, December 7, page 91). The strikers, members of the International Brotherhood of Electrical Workers, A.F.L., demanded a closed shop.

A temporary injunction was issued by a state court in December, 1946, to restrain the union from interfering with the operation of the co-op. This action followed the felling of two poles by "parties unknown," resulting in a 12-hour interruption of service to some 800 farms. Also, the strikers were charged with attacking non-striking employees.

Closed Shop Pressing

The closed shop issue is likely to become a major cause of disputes among co-ops which already have recognized employee unions. Two strikes involving this point already have been called. Only one co-op, the Tri-County Electric Cooperative of Mt. Vernon, Ill., has concluded a closed shop agreement.

When unionized co-ops undertake to erect their own system extensions, as provided by REA's force account loan contracts, their union workers often insist that they be given the construction work. In many cases, the higher wages paid to permanent union crews, as compared with the cost of non-union construction labor, would increase the cost of the project beyond the ability of the co-op to pay.

I.B.E.W. workers of the Cuivre River Electric Cooperative, Inc., of Troy, Mo., struck because of this issue last spring while negotiating for recognition of their union. Willing to recognize the bargaining unit, the co-op directors insisted, however, that the union contract exclude construction of new lines. At that time the co-op was planning extensive system additions under a force account project. The union rejected this proposal and filed unfair labor practice charges against the co-op with the National Labor Relations Board. NLRB conducted a hearing but has rendered no decision.

Union recognition, chief cause of all co-op disputes to date, was the issue in a two-month-old strike of I.B.E.W. workers of the Jackson County Rural Electric Cooperative Corporation of McKee, Ky. Directors of this co-op said they would not recognize any union of their employees.

Such resistance to efforts to organize co-op workers has been the rule, rather than the exception, union spokesmen say. Because the average farmer works from dawn to dusk and his income is dependent upon the success of his crops, he has little or no sympathy for the electrical workers' demands for standard wages and hours. This hostility is especially evident in the South and Midwest, though by no means confined to those areas.

Linemen of the Tishomingo County Electric Power Association of Iuka, Miss., struck twice, in November, 1944, and February, 1945, for recognition of their I.B.E.W. local. The co-op agreed to meet wage and other demands but refused to sign a union contract. Two striking linemen carried their case to the NLRB. Meanwhile the co-op employs three non-union linemen.

These disputes recall the bitter strikes of two I.B.E.W. locals in 1942, both seeking union recognition. Service was interrupted for several weeks on the power system of the South Central Rural Electric Cooperative, Inc., of Lan-

(*Continued on page* 234)

MEMBERS OF THE BOARD—More and more REA cooperatives are putting women on their boards of directors. Here are two who attended a recent meeting in Washington, Mrs. C. P. Taylor, left, a director, and Mrs. Oscar Sears, president of the board of the Carroll Electric Cooperative Corp., Berryville, Ark.

Controller Charges E.E.I. with 'Trick' TVA Figures

Holding that the Tennessee Valley Authority had a net income of $16,214,000 from power operations during fiscal 1946, E. Arnold Sunstrom, TVA controller, has charged Edison Electric Institute statisticians with employing "trick" calculations to show that TVA had an over-all deficit of $8,041,000 for the period (ELECTRICAL WORLD, January 11, Page 5).

The TVA executive said the E.E.I. analysis was reached by deducting all costs of navigation, flood control, reforestation, soil conservation, fertilizer production, and regional research from the authority's net power earnings.

"By means of the trick employed in the analysis by the E.E.I.," Mr. Sunstrom said, "a municipality-owned power operation anywhere could be thrown into the red by simply charging against it as operating expenses the cost of city police and fire protection, the health department, the schools, and similar services."

Blames City for Lost Logs

Claiming faulty operation of Seattle City Light's hydroelectric dams on the Skagit River caused them to lose large numbers of logs, four companies have filed damage claims totaling more than $36,000 with the city comptroller. The Coos Bay Pulp Co. of Anacortes asks $15,000; Puget Sound Pulp & Timber Co., Bellingham, $10,000; C. B. Lumber & Shingle Co., Everett, $8,537, and John S. Pankratz, Seattle, $3,092.

SEC RULINGS

The Securities and Exchange Commission recently issued a series of orders affecting electric utility companies.

WISCONSIN POWER & LIGHT CO.'s proposal to issue and sell 100,000 shares of $10 par value common stock to its parent, North West Utilities Co., for $1,000,000 has been authorized. The subsidiary intends to use the proceeds to pay part of the cost of additions and improvements to its utility facilities. (Release No. 7103).

CRESCENT PUBLIC SERVICE CO.'s fees and expenses aggregating $94,549, incurred in connection with the company's program and the recapitalization plan of Central Ohio Light & Power Co., a subsidiary, have been released from commission jurisdiction. Of the total Central Ohio Light will pay $29,952. (Release No. 7101).

NY PA NJ UTILITIES CO.'s dissolution program, involving the surrender for cancellation of all of its outstanding stock, now held by General Public Utilities Corp., has been approved. In return for its securities, NY PA NJ will turn over to General Public all of its assets, which include the following common capital stocks: 775,914 shares Rochester Gas & Electric Corp.; 260,000 shares Staten Island Edison Corp.; 1,053,761 shares Jersey Central Power & Light Corp.; 360,780 shares Metropolitan Edison Co.; 87,500 shares New Jersey Power & Light Co. and 46,484 shares New York State Electric & Gas Corp. (Release No. 7105).

PHILADELPHIA CO.'s corporate simplification proceedings will be heard at a hearing postponed from January 21 to February 25. Also involved are several of the company's subsidiaries. In addition, the commission postponed until February 10 the date for the filing of answers by the respondent companies. (Release No. 7117).

GENERAL PUBLIC UTILITIES CORP.'s amended proposal, covering the sale to three banks of $4,750,000 of nine-year notes and the use of the proceeds, together with Treasury funds, to redeem outstanding convertible debentures, due January 1, 1956, has been approved. At the same time the commission vacated a condition imposed on its prior order which approved the original proposal. This was that General Public Utilities should not be permitted to redeem its convertible debentures unless the redemption was accomplished in such a manner as to preserve for holders of the unexchanged 8 percent gold bonds, due 1940, of Associated Gas & Electric Corp., benefits accruing to them through the conversion privilege. The convertible debentures are transferable into common stock of General at the option of the holders. (Release No. 7068).

AMERICAN WATER WORKS & ELECTRIC CO.'s recapitalization plan has been rejected, and the company was given 30 days in which to file amendments providing for additional payments to various classes of security holders involved. (Release No. 7091).

MANUFACTURERS LIGHT & HEAT CO.'s application to borrow $1,000,000 from its parent, Columbia Gas & Electric Corp., has been approved. The loan, part of a $7,000,000 borrowing program to pay for Manufacturers' construction obligations before August, 1948, will meet current costs of the last two months. It will be secured by 3¼ percent promissory notes. (Release No. 7093).

NORTH AMERICAN CO.'s and North American Light & Power Co.'s request for postponement of the hearing scheduled for December 19 on various matters involving North American Co. and its subsidiaries has been granted. Hearing has been set for January 21. (Release No. 7081).

INDIANA SERVICE CORP.'s amended plan of recapitalization has been approved. It provides for the sale of the corporation's new common stock to American Gas & Electric Co. and use of the proceeds to aid in financing the retirement of certain classes of existing securities. (Release No. 7086).

•

Buying Private Power

Indiana & Michigan Electric Co. has signed a ten-year contract with Portland, Ind., to augment its municipal plant with 2,000 kw. of power and an additional 2,000 kw. if required. Frequent breakdowns at the Portland plant have affected both industrial and domestic customers in the city. A 33-kv. line, 15½ miles long, from Dunkirk to Portland has been completed, the utility announced.

MEETINGS

Previously Listed

Agricultural Development Clinic—Fairmont Hotel, Fairmont, W. Va., January 24-25.

American Institute of Electrical Engineers—Winter meeting, New York, January 27-31.

Electrical Engineering Exposition—71st Regiment Armory, New York, January 27-31.

Edison Electric Institute—Prime Movers Committee, Van Curler Hotel, Schenectady, N. Y., February 3-4; Industrial Power and Heating Section, Hotel Continental, Kansas City, Mo., February 5-7; Transmission and Distribution Committee, Atlanta Biltmore Hotel, Atlanta, Ga., February 10-11; Meter Committee, Robert Treat Hotel, Newark, N. J., February 10-12; Electrical Equipment Committee, Atlanta Biltmore Hotel, Atlanta, Ga., February 12-13.

Missouri Valley Electric Association—Annual Power Sales Conference, Hotel Continental, Kansas City, Mo., February 5-7.

Association of Edison Illuminating Companies—Committee on Metering and Service Methods, joint meeting with E.E.I. Meter Committee, Robert Treat Hotel, Newark, N. J., February 10-12.

Pennsylvania Electric Association—Systems Operation Committee, Lord Baltimore Hotel, Baltimore, Md., February 13-14. Electrical Equipment Committee, Penn-Harris Hotel, Harrisburg, Pa., February 20-21. Transmission and Distribution Committee, Penn-Harris Hotel, Harrisburg, Pa., February 20-21.

American Society for Testing Materials—Spring meeting and committee week, Benjamin Franklin Hotel, Philadelphia, Pa., February 24-28.

Arkansas P.S.C. Approves New Co-op Rates of Utility

The Arkansas Public Service Commission has approved a revision in the rate schedules under which Arkansas Power & Light Co. sells energy to rural electrification cooperatives.

The revisions drop a "ratchet" clause whereby purchases for non-farm use were billed throughout the year at 65 percent of demand in the month of highest demand and offer a new "industrial" rate described by Chairman C. C. Wine as "the nation's lowest by an electric company to a cooperative." Hereafter, non-farm loads of 100 kw. or more will be billed at standard A. P. & L. rates for the type of service rendered less 20 percent. The basic 5.6 mill rate (at 35 percent load factor) for farm and non-farm loads under 100 kw. remains in effect.

Cooperative leaders, including Thomas B. Fitzhugh, counsel for the Arkansas co-ops' statewide organization, praised the new rate, suggested by a P. S. C. engineer. Deputy Rural Electrification Administrator William Neal described it as better but still not satisfactory. Under the new rate, co-ops will furnish the company meter readings of non-farm loads in excess of 100 kw., and bills for the type of service rendered will be discounted 20 percent.

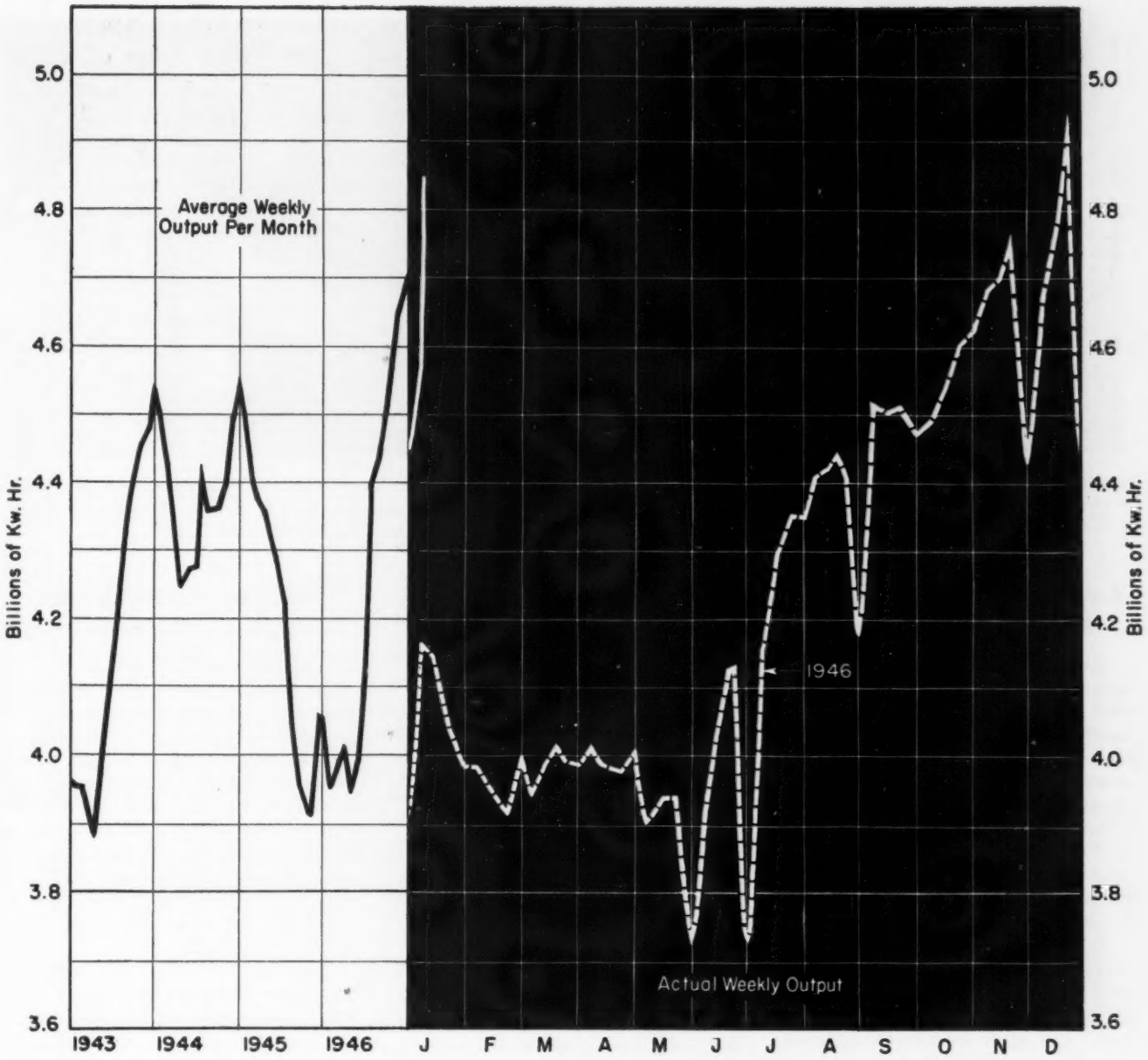
Although company officials asserted that the revisions meant the end of "dual rates," which had long been criticized by REA officials, Neal contradicted them.

"They (the new contracts) offer a mitigation of the burden imposed by dual rates," he said, "and they provide, for part of the energy purchased, a rate which is among the lowest in the country. The improvement in the dual rate structure is one of degree only. Any dual rate is, we believe, unfair and unnecessary, a hindrance to community development. Because the new contracts maintain the dual rate structure, they cannot be considered satisfactory, even though they are more favorable than previously."

•

2 Plants Planned

New York Power & Light Corp. will construct two hydro plants in the Upper Hudson River valley at a cost of $10,000,000. One will be a redevelopment of two small units on the Hudson River at Hudson Falls, which will have a 69,000-hp. capacity. The other will be a 40,000-hp. plant at Stewarts Bridge on the Sacandaga River. The projects are to be completed by March, 1948.



Wyoming Hydro Project Rejected by Reclamation

Proposed construction of a dam and hydroelectric generating plant on the Shoshone River near Cody, Wyo., has been rejected by Reclamation Bureau engineers as infeasible.

Local groups requested the erection of a multiple purpose project for irrigation and power and to provide a bridge across the Shoshone. The Reclamation investigation was partially financed by the City of Cody and the Wyoming Highway Commission. However, the unfavorable report held that other irrigation projects on the river would reduce the water flow at the Cody site, making impossible the generation of any substantial amount of firm electric power. A 2,000-kw. generating unit had been contemplated for the project by its advocates.

Electric Output Curve Swings Upward

The electric output curve swung sharply upward during the week ended January 11, 1947, according to figures released by the Edison Electric Institute.

Reports show that the amount of electrical energy distributed by the light and power industry during the week amounted to 4,852,513,000 kw.-hr., comparing with 4,573,807,000 kw.-hr. during the preceding week. During the week ended January 12, 1946, the amount of electrical energy distributed totaled 4,163,206,000 kw.-hr., this year's figure representing an increase of 16.6 percent.

All the geographical regions reported increases, the largest being reported by the Pacific Coast states, which showed a rise of 24.7 percent. This group was the only region which reported a higher increase than was reported for the week ended January 4.

Weekly Output, Millions Kw.-Hr.

1947		1946		1945	
Jan. 11	4,853	Jan. 12	4,163	Jan. 13	4,614
Jan. 4	4,574	Jan. 5	3,865	Jan. 6	4,427
1946		1945		1944	
Dec. 28	4,442	Dec. 29	3,759	Dec. 30	4,226
Dec. 21	4,940	Dec. 22	4,239	Dec. 23	4,617
Dec. 14	4,778	Dec. 15	4,154	Dec. 16	4,563
Dec. 7	4,673	Dec. 8	4,097	Dec. 9	4,538
Nov. 30	4,448	Dec. 1	4,043	Dec. 2	4,524
Nov. 23	4,765	Nov. 24	3,841	Nov. 25	4,369
Nov. 16	4,700	Nov. 17	3,985	Nov. 18	4,450
Nov. 9	4,682	Nov. 10	3,948	Nov. 11	4,397
Nov. 2	4,628	Nov. 3	3,899	Nov. 4	4,355
Oct. 26	4,602	Oct. 27	3,937	Oct. 28	4,358

Percent Change from Previous Year

	Jan. 11	Jan. 4	Dec. 28
New England	+12.7	+13.2	+10.6
Mid-Atlantic	+10.2	+10.7	+10.6
Cen'ral Industrial	+15.1	+16.5	+17.4
West Central	+ 7.6	+17.9	+14.1
Southern States	+23.8	+26.3	+26.3
Rocky Mountain	+11.8	+13.7	+ 9.2
Pacific Coast	+24.7	+24.1	+26.0
Total United States	+16.6	+18.3	+18.2

TO HANDLE COAL FOR TOLEDO—The new coal handling system, left, at the Acme plant of the Toledo Edison Co. Right, Henry H. Kerr, vice-president in charge of operations, throwing the switch to dump the first car of coal. With him is Glenn Sampson, engineer in charge of construction. The new system will provide storage for 100,000 tons of coal

Toledo Edison Co. Spends $800,000 for Coal System

An $800,000 coal-handling system designed to accommodate a plant burning rate of 50,000 tons of coal a month has been installed in the Acme plant of the Toledo Edison Co. The new system replaces 30-year-old equipment which was designed for less than half of the Acme plant's present capacity. The new system can be operated by a single shift working five eight-hour days a week as compared to the old system which had to be operated on a three-shift basis.

The new system consists of a car dumper, Bradford breaker, and four silos with a total capacity of 2,000 tons, all connected by a belt conveyor system. The open storage yards have a capacity of 100,000 tons.

•

Sacramento, Calif., Refuses to Recognize A.F.L. Union

Directors of the Sacramento (Calif.) Municipal Utility District have declined to enter into a contract with the local unit of the International Brotherhood of Electrical Workers, A.F.L., refusing to set a precedent in the state for collective bargaining by a civil service agency.

A board statement declared that conclusion of the contract offered by the union would be "in conflict with the basic theory of the law under which public agencies operate in California. No civil service agency in this state has entered into such a contract," it added.

(This statement, however, does not appear to be correct as the City of Vallejo has a contract with a labor union representing the employees of its municipally owned motor transportation system who are under civil service.—Ed.)

The Utility District took over Sacramento distribution facilities of the Pacific Gas & Electric Co., January 1, and the union—present bargaining agent for P.G. & E. employees in the area—is seeking to continue its representation under the new management.

•

Officers for 1947 Elected by Interstate Power Club

The Interstate Power Club, an organization of industrial managers of various utility companies operating in Delaware, New Jersey, Pennsylvania, New York, Ohio, and the New England states, has elected W. C. Pierce, of the Eastern Shore Public Service Co. of Virginia, Eastern Shore Public Service Co. of Maryland, and the Southern Division of Delaware Power & Light Co., chairman for 1947.

J. V. Gallagher, Jersey Central Power & Light Co., will be vice-chairman. Directors elected were John B. Taylor, Atlantic City Electric Co.; W. P. Robinson, Public Service Electric & Gas Co.; F. T. Brooks, Philadelphia Electric Co.; L. D. Flinchbaugh, Central Hudson Gas & Electric Co.; and S. R. Knapp, Connecticut Light & Power Co.

•

195,000-Hp. Plant Planned

Shawinigan Water & Power Co. will build a third power plant in the gorge at the foot of Shawinigan Falls to house three 65,000-hp. units. The plant is to go on the line late in 1948, and the cost will be $12,500,000.

West Penn Co. Establishes 8 Memorial Scholarships

As a memorial to 15 employees of the West Penn Power Co. and its affiliated companies, who lost their lives in the services during the war, the company has established eight college scholarships for younger employees and children of employees. Each of the eight will be awarded to winners of a competitive examination judged by a recognized impartial agency, and each winner will receive $250 a semester towards the cost of his education in any recognized college.

Beginning in 1947, two scholarships will be awarded for one year, two for two years, two for three years, and two for four years. From 1948 onward two scholarships for four years will be available annually. Scholarships, however, can be revoked at the end of any year for failure in studies or unsatisfactory personal conduct.

Of the two awards each year not more than one will be available for younger company employees who have completed two years or more of employ with the company before May 1 of that year.

•

Higher Pay May Up Rates

Wage increases for utility workers in Pennsylvania may result in higher rates for utility services, it has been indicated by John Siggins, Jr., chairman of the Public Utility Commission. He expressed the personal opinion that the commission would grant increased tariffs if wages were boosted because utilities are guaranteed a "fair return by law."

Electrical World OPINION

The Implicit Right to Strike?

THE SERIOUS EFFECT of widespread and prolonged strikes has resulted in an almost enthusiastic spate of remedies, some of which come from qualified observers, many of which do not. The simplest remedy, and one suggested increasingly often, is merely to outlaw strikes. In answer to this, it is increasingly common to reply dogmatically:

"You can't abolish the right to strike. That's unconstitutional."

Without attempting to argue the merits or demerits of a prohibition against strikes—either across the board or in selected, vital industries—both amateur and professional practitioners of labor medicine should pause long enough to realize that there is no constitutional right to strike, but only a constitutional prohibition against involuntary servitude and peonage. Having paused thus long, they should remain enough longer to learn that there is a world of difference between the right to strike while still retaining one's job rights and the right to strike without a public guarantee of one's job rights. The primary difference between a strike today and a strike before the Wagner Act became law—aside from the mass support available today which could be mustered only rarely then—is the fact that today, the striker almost invariably retains certain specified job rights.

Perhaps, then, the answer lies not in abolishing the right to strike, but in removing some or all of the absolute protection of job rights now afforded strikers.

Social Engineering

ENGINEERS often disdain suggestions that they participate in civic affairs for the good of the country, the good of the profession, and their own good. The reason is that most of them are so wedded to ideas expressible in fairly precise quantitative terms that they are out of their element wherever influences and phenomena are subject to whims, caprice, propaganda or demagogic perversion. But there loom circumstances which may change this attitude. In fact, it may not be many years before the electrical engineer will be the "answer man," if not the fixer of destiny, in the social realm where trends are so confused and confusing.

Why? Solely because it was the electrical engineer who, needing it for solution of his complex circuits, developed the network calculator and differential analyzer. There is hardly an electrical engineer who does not know that those devices can solve in minutes what would take hours by any other method. In fact, the machines will derive plots or answers to situations for which the mathematics has not yet been produced.

Potentiality of the calculators lies in the simple fact that the analyses of the sociologist, economist, mass psychologist, political scientist and even the meteorologist are piling up more and more straw-polls, more statistics, more correlations and more semi-quantitative hypotheses. What is lacking in most of those explorations is the very thing the automatic calculators can do, namely resolve a welter of heterogeneous trends and influences into a composite that elevates the real determinants to deserved significance. It would be a great boost for the whole engineering profession if its materialistic and utilitarian tools should prove to hold the answers to dozens of the apparently non-quantitative worries of mankind.

Atomic Control Demobilized

CLOSING DAYS of the year saw three events which mark positive steps in the strides of atomic fission toward wholesome peace-time application. Adoption of the Baruch report by the United Nations Atomic Energy Commission by no means solves the terrifically intricate matter of international control but it does betoken a world-wide determination to forge the tools designed to nip in the bud any clandestine perversion to military aggression. With that alone to serve as a guide for this nation, as well as the others, the result could be wholly one of restraint. Efforts to release the secrets of the processes or to make any of the fissionable material available for peaceful cultivation would be confronted with rows of hurdles set up by the military and diplomatic minds almost certain to dominate the international situation.

But, most fortunately, there has come, in fine synchronism with the Baruch program, the establishment of the United States Atomic Energy Commission. It is all set to take over the huge and ramified operations previously carried on by the Manhattan District.

With the control now in civilian hands, as so long and persuasively urged by the scientists who chafed under the curbs imposed by the army group, the nation can expect an orderly unfolding of the tremendous potentialities of atomic fission. Warning has, however, been given by the new general manager (Carroll Wilson) that in no sense are the bars all down even though declassification of the technical knowledge will be expedited. That progressive release of information in itself

will help greatly to shorten the period of years it will take to make an atomic power plant a practical commercial reality. Meanwhile any headlong disclosures of issues detrimental to our national security are to be prevented by a continuation of the same protective measures that proved so effective while Oak Ridge and Hanford were among our best guarded war secrets and are still plenty comprehensive. Thus does atomic power emerge cautiously but surely from its epical incubation.

Columbus Faced the Facts

PROPOSALS that the city acquire Georgia Power Co. holdings in Columbus, Ga., had been widespread and continuing last summer when an engineering firm submitted a report justifying municipalization. Mayor Sterling Albrecht, a public ownership leader, turned the report over to a group of 15 leading citizens for study and recommendation, with the assertion that "If they decide against it, we are through—at least as far as I am concerned."

The citizens' committee decided against it, saying in part: ". . . Your committee would consider it bad faith . . . if it revoked this franchise without proper reason . . ." ". . . The . . . company took over the power properties of Columbus in good faith and by force of its own efforts, capital, and energy has developed a successful business . . . We feel it unfair . . . to take over this business now solely because the city needs the money . . ." ". . . The motive has been purely and simply to take over the business for a profit. We do not believe that the city would want to get into the power business if it thought the business would not be profitable."

Had the company been asked to write the report, rather than "15 leading citizens," it could hardly have presented a better case for private ownership. Why indeed, should anyone revoke a franchise before expiration without just cause? Why indeed, should anyone sit by enjoying the fruits of another's efforts and then, with success achieved, seize them? Above all, if a city needs money, why should it stop at acquiring a successful power and light business? Why not take over retail stores, banks, industries, and all the rest?

All these questions and others are implicit in the citizens' committee's justification of its recommendation. To seal its decision, the committee added another point, perhaps the most persuasive of all. It said:

". . . Incidentally, the (engineering report's) figures are predicated on the rates remaining the same for the next 15 years. The history of the Georgia Power Co.'s operation in Columbus has been one of steadily declining power rates."

Here is evidence to assure the most positive opponents of private ownership. Perhaps it might serve additionally as "character testimony" in the record of Georgia Power's application to develop the Clark Hill project.

WASHINGTON COMMENT

By R. N. LARKIN

PRESIDENT TRUMAN'S recent economic report puts into words the change in thinking about large-scale public works programs which has been developing.

Over 14 years, public works have become a most popular federal activity, both with legislators and administrators. They began as a counter measure against depression. Motivation was varied. Some believed in "pump priming." Others admired the "tax and tax, spend and spend, elect and elect" philosophy. Universally they were agreed to be preferable to the dole. Whatever the motivation, their usefulness in providing jobs for the jobless continued through the last decade and up to the war.

During the war, of course, little was done with public works, nor has the need for them, on the basis of mass unemployment, arisen since V-J Day. But the need for public works continues to exist for those who have a heavy personal stake in them, primarily government people. With mass unemployment non-existent and, according to those who should know, not an immediate threat in the future, those who want to continue public works have been faced with the necessity of finding new justification for their programs lest they be discontinued. The new justification is found in Mr. Truman's economic report, as follows:

"Instead of regarding public works as the first and foremost device to restore our whole economy when it sags, we should attempt to stabilize public works construction according to our long-term needs. Increasing regularization of public works expenditures . . . over a long period will offer an assurance of a demand for capital, of a market for materials and equipment, and of a field for employment which will assist in stabilizing that segment of the business world. This policy by no means forestalls the expansion of public works . . . if recessions or depressions should unfortunately develop. The very procedure necessary for long-term, regularized expenditure will pave the way for more effective emergency use than in the past."

By law, this report is a recommendation on national economic policy. Its adoption rests with Congress. The important thing is that the Administration has surveyed the national debt and the need for its reduction, the tax level and the need for its reduction, and the non-existence of any need for pump priming or mass unemployment relief, and—having considered them all—negotiated the right-about-face demanded by a continuation of large scale public works in times such as these.

Statistics of the Electrical Industry

HIGHLIGHTS OF THE YEAR

Output: 223,334,000,000 kw.-hr.

Practically the same as in 1945. Fuel capacity accounted for 65.3 percent, slightly more than in previous year. Proportions of output by power companies and government remain unchanged at 81.2 and 18.8 percent.

Capacity: 50,196,000 kw.

Net addition to capacity only 85,000 kw. in the year. No significant changes from 1945 in proportions of fuel and hydro capacities or of government and privately owned, 70-30 and 80-20 percent, respectively.

New Capacity: 361,172 kw.

Only about 25 percent of new capacity planned for 1946 was installed. Plans for 1947 are for 3,027,922 kw. and for 1948 and later, 7,325,525 kw. Of capacity programmed for installation in 1947, 85 percent is fuel power.

Energy Sales: 191,000,000,000 kw.-hr.

Less than 2 percent under sales for 1945 and only 3.5 percent under war year high of 1944. Sales to large light and power customers continued to decline slowly and to residential and commercial customers to rise rapidly.

Revenue: $3,450,000,000

As in 1945, small decrease in energy sales was accompanied by slight increase in revenue. Residential customer annual averages of usage of 1,327 kw.-hr. and bill of $42.93 show increment cost per kw.-hr. for increased usage over 1945 of less than one cent.

Customers: 36,100,000

More customers added in 1946 than in any other past year. Largest proportionate increase was in number of rural customers. Residential group now totals 29,743,000.

Financial: $1,082,446,950

Refunding about a third under 1945 and new capital over four times larger, but still only small part of total financing. Operating expenses took over 45 percent of gross, and plus taxes nearly 65 percent.

Budget: $1,400,000,000

Contemplated expenditures for construction in 1947 about 50 percent above previous high of 1930. Distribution still absorbing largest share of proposed construction cost.

REA: 2,424,000,000 kw.-hr. in Sales

Discontinuance of energy supply to aluminum plant brings operating ratios more nearly into line as representing rural service.

Manufacturing: Some Productions Rise

1946 was a troubled year for electrical manufacturers and productions fell far short of goals. But in some lines, particularly refrigerators and other appliances, outputs were higher than conditions gave cause to expect. And E.M.I. production index remains far above that of F.R.B.

Trend

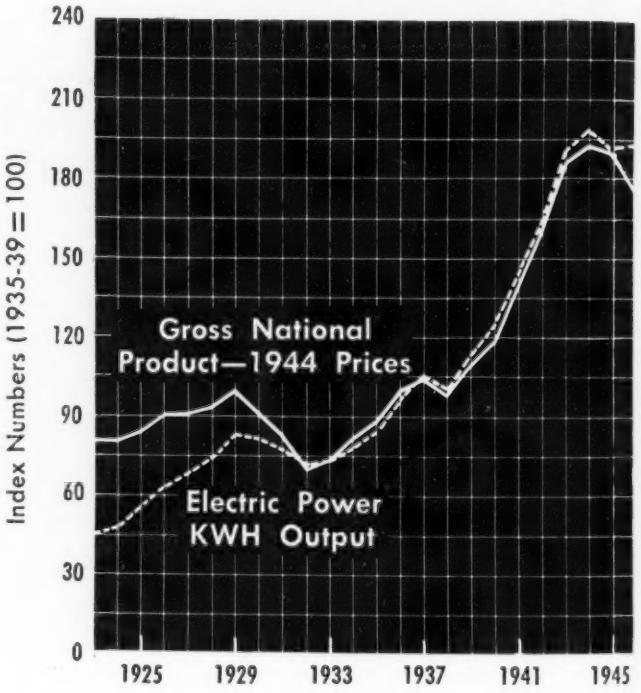
gross national product and electricity output

OUTPUT of electricity both symbolizes and measures the progress of mankind toward a better life. Never was this more evident than in 1946, the year of reconversion from war to peace. Although for 1946 as a whole the product of U. S. industry fell from its war-time high, the standard of living of U. S. citizens—including their consumption of electricity—rose to a new peak.

This simple fact is pictured in the accompanying chart, which reveals that output of electricity inched ahead in 1946 despite a decline in the gross national product (which embodies the total value of all goods and services produced.) An increased use of electricity in the home, on the farm, and by commercial establishments was responsible for this advance in energy output.

Nevertheless, this divergence between the course of electric power output and the gross national product is a temporary matter, as an examination of the movement of each over the past quarter century makes abundantly clear. For the growth of the national product represents in large part an expansion of industrial output. And electricity is an essential element in this process. War-time experience illustrated this fact most dramatically. From 1939 to the war peak, industrial production more than doubled while consumption of electric power by industry jumped 130 percent.

In 1946 the gross national product fell because government spending for war equipment was cut drastically. But consumers, released from the fetters that bound them in war time, immediately stepped up their buying. Much that they wanted was not available, and this applied particularly to electric appliances and equipment. Nevertheless, consumers used existing appliances more intensively and quickly put into employment all new ones that were turned out. The result was the record advance in sale of electricity to households and farms that is reviewed in some detail in subsequent sections.



The year 1947 opens in an atmosphere of uncertainty and debate concerning the course of industrial production throughout the coming year. Most business forecasters look for some business letdown during 1947 as the economy moves into a sellers' market. But the strong elements of growth that have played so prominent a part in pushing electric power output upward this past year should again make the utilities an exception to this rule.

Outstanding Facts

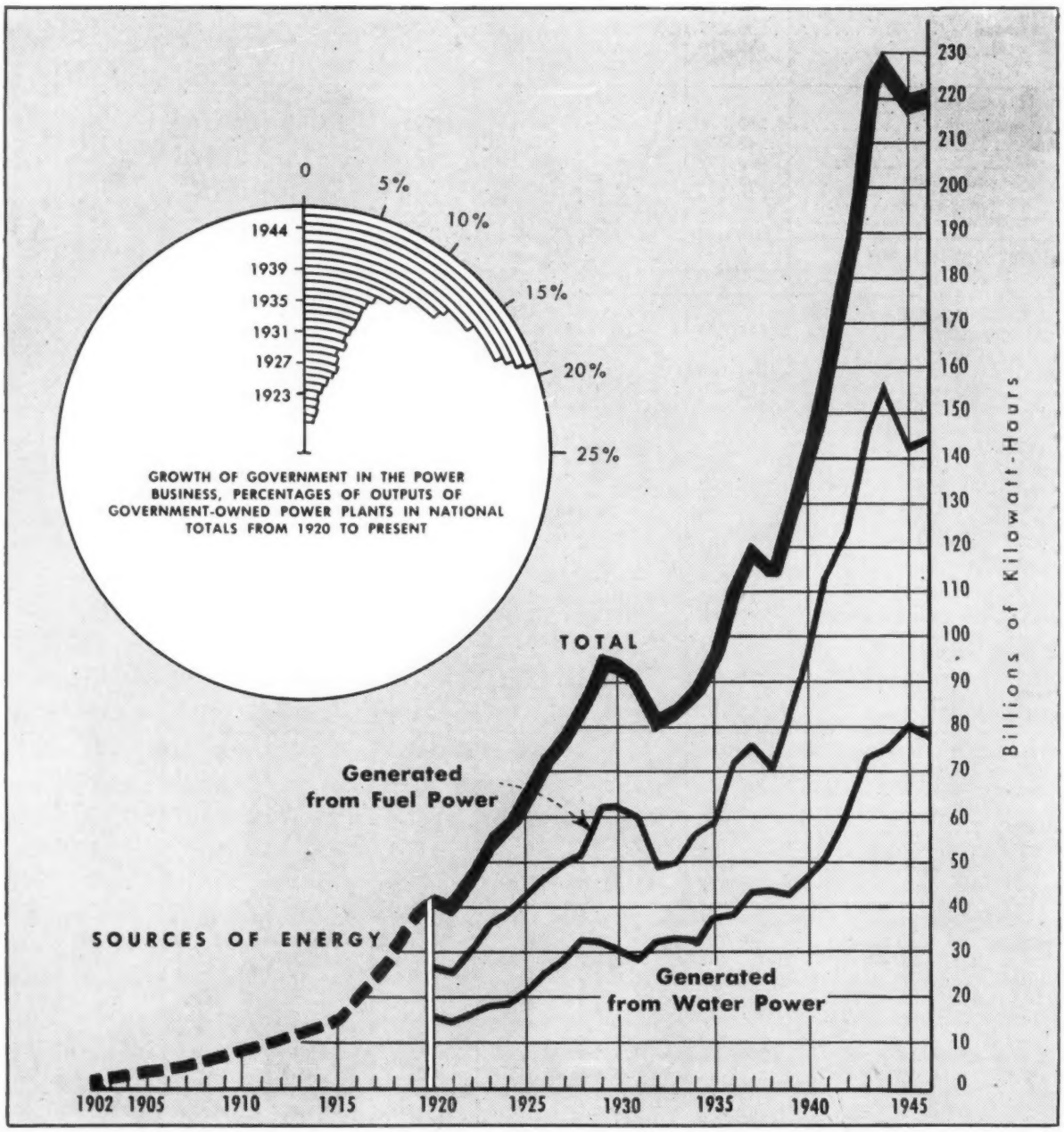
a summary statement

	1939	1940	1941	1942	1943	1944	1945	1946*
FIXED CAPITAL ($1,000,000)	12,388	12,658	12,964	13,082	13,143	13,050	13,058	13,700
Securities issued [1] ($1,000)	996,347	989,459	740,832	356,254	371,062	1,018,228	1,361,922	1,082,447
New capital	16,219	92,376	97,065	92,666	9,920	15,587	39,699	172,846
Refunding	980,128	897,083	643,767	263,588	361,141	1,002,641	1,322,253	909,601
REVENUE ($1,000)								
From ult. consumers	2,289,583	2,440,218	2,665,057	2,885,843	3,077,643	3,276,751	3,341,518	3,450,000
Rural	45,484	49,473	64,396	75,027	76,617	82,842	90,344	105,000
Residential	843,158	895,951	938,229	990,185	1,029,260	1,097,726	1,167,356	1,242,000
Small light and power	660,683	689,253	725,117	767,279	776,228	817,356	850,213	925,000
Large power and light	572,659	631,428	758,083	828,318	961,642	1,043,392	1,001,957	960,000
Other consumers	167,597	173,752	179,233	195,034	233,996	235,436	231,648	218,000
EXPENDITURES ($1,000)								
Capital [2]	430,000	596,580	654,148	522,200	305,904	340,284	408,929	718,169
PRIVATE COMPANIES ($1,000)								
Operating revenue	2,148,000	2,277,000	2,475,000	2,611,000	2,807,000	2,955,000	3,012,000	3,100,000
Operating expenses	798,000	863,000	950,000	1,011,000	1,117,000	1,225,000	1,264,000	1,401,000
Taxes	352,000	404,000	521,000	630,000	688,000	677,000	662,000	600,000
Salaries and wages	340,000	355,000	376,000	381,000	371,000	388,000	452,000	550,000
OUTPUT (1,000,000 kw.-hr.)								
Generated	130,336	144,985	168,170	189,181	220,728	230,645	222,486	223,334
From steam	85,007	95,675	115,276	123,356	145,045	154,828	140,435	143,030
From water power	44,021	47,753	51,262	64,179	73,922	14,021	79,970	77,954
From internal combustion	1,307	1,557	1,632	1,646	1,761	1,800	2,080	2,350
CAPACITY (1,000 kw.)								
Generator ratings	40,318	41,639	44,092	46,407	49,305	50,278	50,111	50,196
Steam	28,047	29,019	30,823	32,332	34,178	34,609	34,112	34,256
Hydro	11,415	11,675	12,264	13,025	14,067	14,604	14,912	14,840
Internal combustion	856	945	1,005	1,049	1,060	1,064	1,087	1,100
FUEL CONSUMPTION								
Coal (1,000 short tons)	46,223	53,398	64,760	68,420	79,665	82,310	74,730	70,160
Oil (1,000 bbl.)	17,423	16,722	20,250	15,280	18,085	20,810	20,230	31,170
Gas (billion cu. ft.)	191	183	205	239	301	360	326	303
ENERGY SALES (1,000,000 kw.-hr.)								
Ult. consumers	105,768	118,643	140,060	159,408	185,889	198,161	193,558	191,000
Rural	1,881	1,991	2,352	2,890	2,996	3,373	3,668	4,475
Residential	21,034	23,318	25,124	26,937	28,621	31,266	34,184	38,400
Small light and power	20,722	22,373	24,628	27,234	29,071	29,837	30,438	32,925
Large power and light	51,108	59,557	76,060	88,378	105,778	115,187	107,490	99,600
Other	10,972	11,405	11,896	13,968	19,423	18,498	17,778	15,600
CUSTOMERS (1,000)								
Total number	29,105	30,191	31,607	32,210	32,396	33,048	34,031	36,100
Rural	634	686	987	1,096	1,088	1,144	1,234	1,360
Residential	23,965	24,952	26,025	26,620	26,872	27,371	28,117	29,743
Small light and power	4,215	4,260	4,300	4,219	4,168	4,263	4,398	4,709
Large power and light	184	178	173	150	147	153	162	165
Other	106	115	122	125	121	118	120	123
People in homes served (1,000)	100,855	97,424	102,695	104,882	105,000	107	110	116
Per cent of total civil population	77.3	74.0	78.0	77.4	77.3	80.0	81	85
EMPLOYEES, total	247,000	250,000	256,000	221,000	205,000	200,000	222,000	246,000

* Estimated, generally on ten months' operations. [1] Includes warrants and rights. [2] Excludes Federal Projects.

Output

223,334,000,000 kw.-hr.



SOURCE AND DISPOSAL OF ENERGY

(In Millions of Kw.-Hr.)

Year	Generated from		Total Generation	Add Imports from Canada	Less Energy Used by Producer	Total for Distribution	Losses	Sales to Ultimate Consumers
	Fuel Power	Water Power						
1932	49,055	33,322	82,377	446	5,248	77,575	13,864	63,711
1933	50,678	34,058	84,736	613	4,910	80,439	14,523	65,916
1934	57,093	33,713	90,806	893	5,499	86,200	15,118	71,082
1935	59,430	39,034	98,464	901	5,669	93,696	16,100	77,596
1936	72,665	39,516	112,181	1,054	5,826	107,409	17,365	90,044
1937	77,348	44,489	121,837	1,733	6,428	117,142	17,783	99,359
1938	71,847	44,834	116,681	1,867	6,990	111,558	17,826	93,731
1939	86,314	44,022	130,336	1,900	7,734	124,502	18,735	105,768
1940	97,232	47,753	144,985	937	7,268	138,654	20,011	118,643
1941	116,908	51,262	168,170	927	6,335	162,762	22,702	140,060
1942	125,002	64,179	189,181	1,448	6,611	184,018	24,611	159,407
1943	147,027	73,943	220,970	1,537	9,729	211,124	25,235	185,889
1944	156,704	74,032	230,736	1,597	6,541	225,792	27,631	198,161
1945	142,516	79,970	222,486	1,773	3,368	220,891	27,333	193,558
1946*	145,380	77,954	223,334	1,793	4,370	220,757	29,757	191,000

Sources: Federal Power Commission and Edison Electric Institute. * Estimated on revised basis which excludes former Mining and Manufacturing and Railroad and Railway classifications.

PRODUCTION OF ELECTRIC ENERGY BY OWNERSHIP

(In Millions of Kw.-Hr.)

Year	Privately Owned	Government-Owned		
	Electric Utilities	Local†	Federal	Total Government
1932	74,488	4,460	445	4,905
1933	76,668	4,614	458	5,072
1934	82,079	4,822	357	5,179
1935	89,330	5,403	555	5,958
1936	102,293	5,951	1,072	7,023
1937	110,464	6,606	1,843	8,449
1938	104,090	6,693	3,029	9,722
1939	115,078	7,088	5,476	12,564
1940	125,411	7,842‡	8,584	16,426
1941	144,290	9,705	10,794	20,498
1942	158,052	11,034	16,893	27,928
1943	180,247	13,027	24,484	37,511
1944	185,850	13,473	28,866	42,339
1945	180,926	13,559	28,001	41,560
1946*	181,344	15,149	26,841	41,990

Source: Federal Power Commission.
* Estimated. † Includes cooperatives, power districts and state projects.
‡ 1940 and following data revised to exclude production by publicly owned transit systems.

AT THE END of 1946 the week-by-week output was surpassing the pace set by the war-time production in 1943 and 1944 to the extent of some 2 or 3 percent, but for the year as a whole the nationwide kilowatt-hours were about an identical amount below 1944. The answer was to be found in the flat output tendency which ruled from mid-1945 to mid-1946.

Obscured by the mere year-round totals are the sharp valleys caused by the coal strikes and the mark-time characteristic of the period when industrial strikes were concatenated. Another factor hidden in the totals is a deepening of the holiday recessions in July, September and December.

Fuel in 1946 contributed 65.3 percent of the total; this is higher than the 63.8 percent of 1945 but substantially lower than the 68.7 percent of 1944.

Privately owned enterprises generated 81.2 percent of the national total output (same as 1945), the federal projects 12 percent and the local-government utilities 6.8 percent.

ENERGY PRODUCTION BY REGIONS

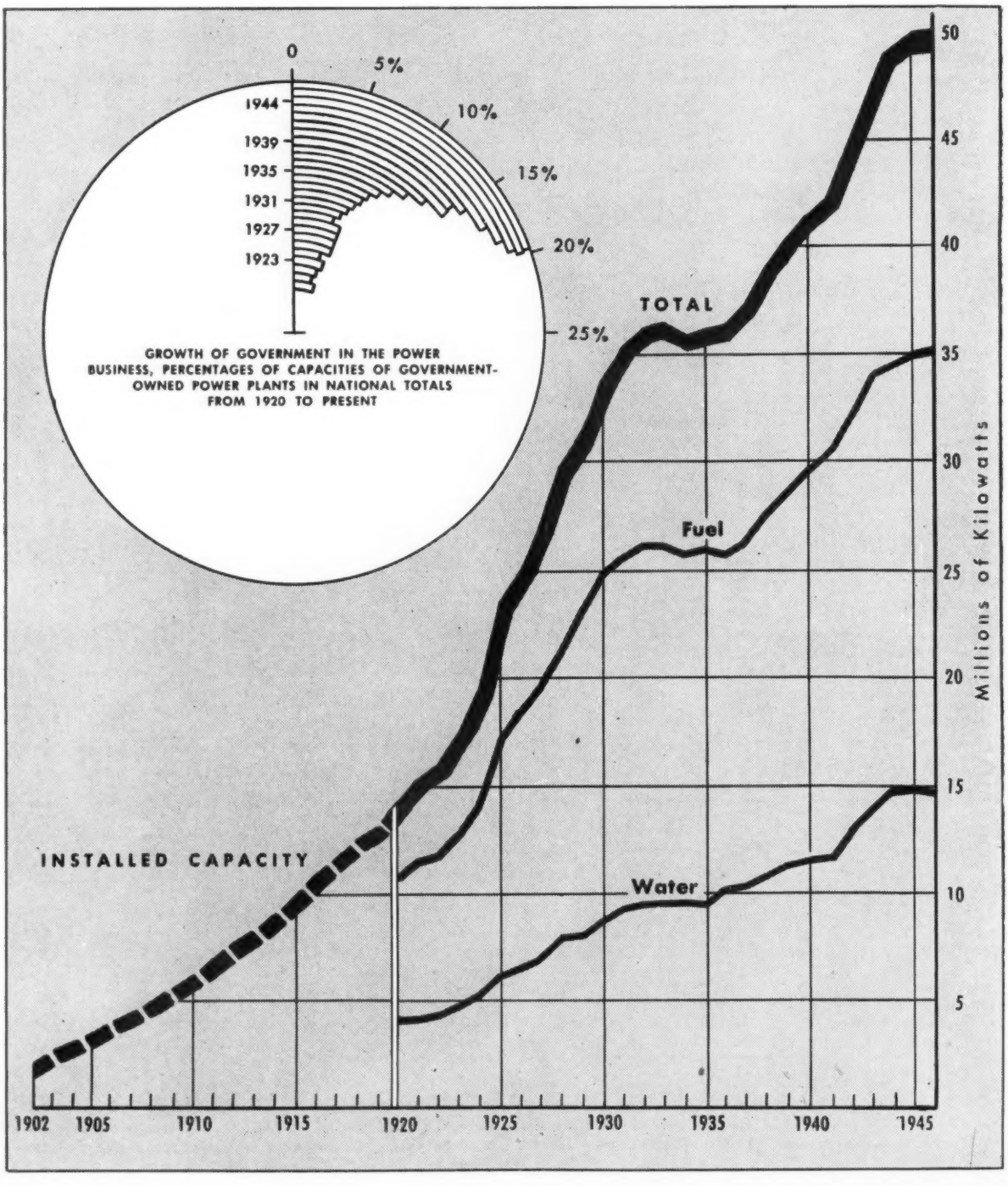
(In Millions of Kw.-Hr.)

Region	1943			1944			1945			1946*		
	Total	Hydro	Fuel	Total	Hydro	Fuel	Total	Hydro	Fuel	Total	Hydro	Fuel
New England	11,647	3,766	7,881	11,988	3,116	8,872	11,805	4,087	7,718	12,333	3,633	8,700
Middle Atlantic	48,857	9,720	39,137	48,196	8,630	39,566	46,678	10,522	36,156	47,096	9,367	37,729
East North Central	50,232	3,554	46,677	53,682	3,002	50,678	50,921	3,339	47,582	50,206	3,074	47,132
West North Central	11,271	2,804	8,467	12,079	2,782	9,297	12,728	3,025	9,703	13,118	2,774	10,344
South Atlantic	26,755	7,826	18,929	27,948	7,237	20,711	28,285	8,147	20,137	28,904	9,184	19,720
East South Central	15,113	10,063	5,050	16,161	10,931	5,230	16,596	12,356	4,240	16,392	13,523	2,869
West South Central	12,894	899	11,993	14,154	1,053	13,102	13,682	1,428	11,255	13,099	1,430	11,669
Mountain	12,730	11,121	1,609	12,995	11,401	1,594	11,974	10,351	1,622	11,711	9,673	2,038
Pacific	28,259	23,879	4,380	30,985	25,793	5,192	29,818	26,715	3,103	30,475	25,296	5,179
United States	217,758	73,632	144,125	228,188	73,945	154,242	222,486	79,970	142,516	223,334	77,954	145,380

Source: Federal Power Commission. All data revised to correspond with current basis which excludes former Mining and Manufacturing and Railroad and Railway classifications. * Estimated.

Capacity

50,196,000 Kw.



INSTALLED CAPACITY

(In Thousands of Kw.)

Year	Type of Prime Mover		
	Fuel	Water	Total
1932	26,408	9,583	35,991
1933	26,507	9,736	36,243
1934	26,049	9,742	35,791
1935	26,279	9,795	36,074
1936	26,128	10,436	36,564
1937	26,558	10,577	37,135
1938	27,976	11,066	39,042
1939	28,903	11,415	40,318
1940	29,964	11,675	41,639
1941†	30,588	11,817	42,405
1942	32,211	12,842	45,053
1943	34,067	13,884	47,951
1944	34,603	14,586	49,189
1945	35,199	14,912	50,111
1946*	35,356	14,840	50,196

Source: Federal Power Commission. * Data to November 1. † 1941 and following revised to correspond with current basis which excludes former Mining and Manufacturing and Railroad classifications.

GENERATING CAPACITY BY OWNERSHIP

(In Thousands of Kw.)

Year	Privately Owned	Government-Owned		
	Electric Utilities	Local †	Federal	Total Government
1932	32,033	2,122	232	2,354
1933	32,163	2,191	231	2,424
1934	31,547	2,284	288	2,571
1935	31,820	2,316	300	2,615
1936	31,787	2,491	804	3,295
1937	31,958	2,829	833	3,662
1938	33,246	3,090	1,156	4,246
1939	33,908	3,304	1,650	4,955
1940	34,399	3,584‡	1,944	5,528
1941	36,041	3,933	2,371	6,364
1942	37,442	4,395	3,216	7,611
1943	39,128	4,501	4,322	8,823
1944	39,733	4,570	4,886	9,456
1945	40,307	4,723	5,081	9,804
1946*	40,406	4,870	4,920	9,790

Source: Federal Power Commission. * Data to November 1. † Includes cooperatives, power districts and state projects. ‡ 1940 and following figures revised to exclude publicly owned transit capacity.

NET INCREASE in generating capacity in 1946 was negligibly small. The year-end figure of 50,196,000 kw. was only 85,000 kw. larger than the latest data for 1945—50,110,928 kw. New capacity to the extent of some 361,000 kw. was installed but was offset by retirement of about 276,000 kw. Thus 1946, a year of booming over-all consumption, resembled, capacity-wise, the years 1931-36 when the average net gain was only 50,000 kw. a year because consumption was marking time or declining.

Actually, however, the 230,736 million kw.-hr. put out by 49,189,000 kw. in 1944 meant somewhat more hours of working (4,695) than the 223,334 million put out by 50,196,000 kw. in 1947 (4,450 hours) required in working time.

Fuel generation is 70.5 percent of the total and hydro is 29.5 percent. There was absolutely no change from 1945 in the 80.5 percent figure that represents private ownership's holdings in capacity. The government's 19.5 percent generated 22.8 percent of the total national output; thus government's invasion of the field still amounts to only a fifth. Hydro capacity was less by 70,000 kw. than the previous year.

All regions except New England, East South Central and Pacific showed gains, though small; only a single region showed as much as 1 percent gain in capacity and that was the Mountain States with 1.1 percent.

GENERATING CAPACITY BY REGIONS

(In Thousands of Kw.)

REGION	1943			1944			1945			1946*		
	Total	Hydro	Fuel	Total	Hydro	Fuel	Total	Hydro	Fuel	Total	Hydro	Fuel
New England	3,174	893	2,281	3,189	894	2,295	3,198	895	2,302	3,196	895	2,301
Middle Atlantic	10,347	1,587	8,759	10,395	1,593	8,802	10,509	1,591	8,919	10,515	1,591	3,924
East North Central	11,101	747	10,355	11,317	741	10,577	11,506	739	10,768	11,568	738	10,830
West North Central	3,412	568	2,844	3,461	562	2,899	3,466	562	2,904	3,502	562	2,940
South Atlantic	6,016	2,085	3,931	6,258	2,086	4,172	6,557	2,222	4,335	6,574	2,221	4,353
East South Central	3,039	1,850	1,189	3,173	2,022	1,151	3,434	2,221	1,213	3,428	2,222	1,206
West South Central	2,578	301	2,277	2,648	371	2,277	2,694	371	2,323	2,709	371	2,338
Mountain	2,548	1,924	624	2,627	2,003	625	2,647	2,002	644	2,676	2,004	671
Pacific	5,735	3,929	1,806	6,120	4,314	1,806	6,100	4,309	1,791	6,028	4,236	1,793
United States	47,950	13,884	34,067	49,188	14,586	34,604	50,111	14,912	35,199	50,196	14,840	35,356

Source: Federal Power Commission. All data revised to correspond with current basis which excludes former Mining and Manufacturing and Railroad and Railway classifications. * Data to November 1.

New Capacity

10,353,447 kw.

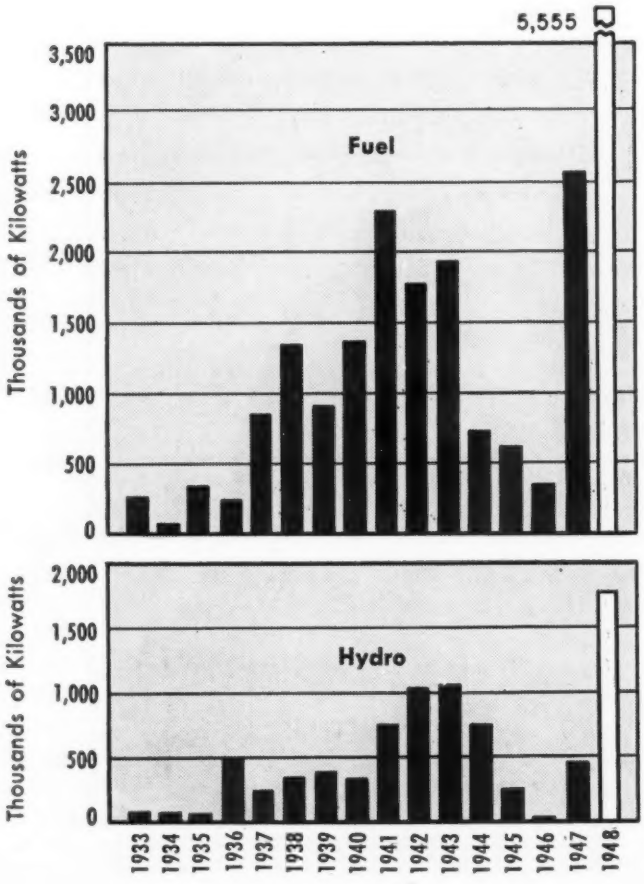
PRESENT PLANS for the installation of new generating capacity amount to more than a fifth of the capacity now in use. Of this increase, about a third is scheduled for 1947, some 3,000,000 kw.

Not since the valley years of the depression of the thirties was such a small installation of generating capacity made as in 1946. Plans for 1946 included 1,462,311 kw. of new capacity, but only 361,172 kw. was installed. Because of necessary retirements of equipment kept in operation beyond normal life by the requirements of war, only about one-fourth of the capacity installed in 1946 appears as net increase to the load-carrying ability of the electric utilities.

NEW CAPACITY ADDED EACH YEAR

Year	Killowatts		
	Fuel	Hydro	Total
1932	466,300	126,155	592,455
1933	251,025	95,325	346,350
1934	52,805	41,900	94,705
1935	347,140	38,950	386,090
1936	231,828	489,865	721,093
1937	873,414	245,346	1,118,760
1938	1,350,303	345,605	1,695,808
1939	914,680	370,150	1,284,830
1940	1,361,094	332,016	1,693,110
1941	2,292,215	786,250	3,078,375
1942	1,756,212	1,026,900	2,783,112
1943	1,835,180	1,088,900	2,924,080
1944	778,037	767,855	1,545,892
1945	621,600	265,800	887,400
1946	355,322	5,850	361,172
1947	2,562,322	464,600	3,027,922
1948*	5,555,425	1,770,100	7,325,525

Source: "Electrical World" Surveys.
* Prospective.



Of the capacity planned for 1947 installation, about 85 percent is in fuel power. And of the 15 percent in water power, about six-sevenths is government owned. For 1948 and later the proportion of water power is larger, around 24 percent. And here again, the larger share, about four-fifths, is government owned.

At present about 20 percent of the nation's generating capacity is owned by government. Apparently this proportion will increase in the next few years since, in the new capacity total shown here, about 25 percent is government owned.

Probably around a third of the capacity planned for installation in 1947 is carry-over from 1946. In ELECTRICAL WORLD'S statistical number last year, there were 75 entries in the tabulation of capacity installations planned for 1946. The present tabulation of installations

made in 1946 contains only 37 entries, less than half than were planned. The disparity is much greater if the comparison is confined to steam power installations, 52 planned, only 19 installed. In terms of steam power capacity planned and installed the comparison is even bleaker, 1,362,600 kw. as against 336,000.

These figures show clearly the effect of strikes, shortages and other hindrances to industrial production in 1946. If such conditions persist into the coming months, only a fraction of the 3,000,000 kw. of new capacity planned for 1947 will be installed and ability to meet load requirements may be impaired.

GENERATING CAPACITY ADDED IN 1946

STEAM

Power Companies	Kw. (Nameplate)
Atlantic City Electric Co.	25,000
Central Illinois Electric & Gas Co.	20,000
Consolidated Edison Co. of N. Y. Group	65,000
Florida Power & Light Co.	50,000
Interstate Power Co. Group	15,000
Kansas Power & Light Co.	15,000
New England Gas & Electric System	20,000
Missouri Utilities Co.	5,000
Public Service Co. of New Mexico	7,500
Sioux City Gas & Electric Co. and Iowa Public Service Co.	3,000
Southern Colorado Power Co.	2,000
Southwestern Public Service Co.	27,500
United Illuminating Co.	6,000
Wisconsin Power & Light Co.	25,000
	286,000
Municipal and Other Public Plants	
Colorado Springs, Colo.	5,000
Consumers Public Power District, Neb.	5,000
Kansas City, Kan.	30,000
Los Angeles, Calif.	4,000
New Ulm, Minn.	6,000
	50,000

HYDRO

Power Companies	
Central Vermont Public Service Co.	600
Interstate Power Co. Group	850
Union Electric Co. of Missouri Group	400
Michigan Public Service Co.	1,000
	2,850
Municipal and Other Public Plants	
Bureau of Reclamation	1,500
Idaho Falls, Idaho	1,500
	3,000

INTERNAL COMBUSTION

Power Companies	
Central Maine Power Co.	60
Florida Power & Light Co.	300
Idaho Power Co.	125
Michigan Public Service Co.	1,036
Oklahoma Gas & Electric Co.	175
Kansas Power & Light Co.	676
Otter Tail Power Co.	4,000
Sioux City Gas & Electric Co. and Iowa Public Service Co.	2,250
Utah Power Co.	700
Dairyland Power Cooperative	5,000
	13,322
Municipal and Other Public Plants	
Consumers Public Power District, Neb.	1,000
Lubbock, Tex.	5,000
	6,000

Kind of Power	Private Companies	Municipal and Federal	Total
Steam	286,000	50,000	336,000
Hydro	2,850	3,000	5,850
Int. Comb.	13,322	6,000	19,322
Totals	302,172	59,000	361,172

GENERATING CAPACITY TO BE ADDED IN 1947

STEAM

Power Companies	Kw. (Nameplate)
Arkansas Power & Light Co.	30,000
Boston Edison Co.	50,000
Central Illinois Electric & Gas Co.	20,000
Central Illinois Public Service Co.	50,000
Central Maine Power Co.	20,000
Central Power & Light Co.	20,000
Commonwealth Edison Co. system	107,000
Connecticut Light & Power Co.	45,000
Consolidated Edison Co. of N. Y. Group	77,500
Consolidated Electric Light & Power Co. of Baltimore	50,000
Consumers Power Co.	50,000
Dairyland Power Cooperative	36,000
Detroit Edison Co.	75,000
Duke Power Co.	65,000
Eastern Shore Public Service Co. of Md.	15,000
Florida Power Corp.	60,000
Florida Power & Light Co.	15,000
Gulf States Utilities Co.	35,000
Holyoke Water Power Co.	15,000
Houston Lighting & Power Co.	37,500
Illinois Power Co.	80,000
Indianapolis Power & Light Co.	37,500

(Continued on following page)

(*Steam, 1947, Continued*)

Interstate Power Co. Group	15,000
Kansas City Power & Light Co.	35,000
Kentucky Utilities Co.	25,000
Long Island Lighting Co.	40,000
Louisville Gas & Electric Co.	50,000
Metropolitan Edison Co.	48,500
Mississippi Power Co.	22,500
Montaup Electric Co.	35,000
Mt. Carmel Public Utilities Co.	4,000
Nebraska Power Co.	15,000
New England Power System Cos.	45,000
New Orleans Public Service Co.	37,500
Northwestern Public Service Co.	7,500
Northern States Power Co.	10,000
Ohio Public Service Co.	50,000
Oklahoma Gas & Electric Co.	22,500
Otter Tail Power Co.	17,500
Pacific Gas & Electric Co.	67,500
Pennsylvania Power Co.	35,000
Philadelphia Electric Co.	162,500
Potomac Edison Co. Group	30,000
Potomac Electric Power Co. Group	50,000
Public Service Co. of Colorado	10,000
Public Service Electric & Gas Co.	100,000
Public Service Co. of New Hampshire	30,000
Public Service Co. of Oklahoma	30,000
San Diego Gas & Electric Co.	50,000
Scranton Electric Co.	25,000
Sheridan County Electric Co.	3,000
Sioux City Gas & Electric Co. Group	17,500
Southern California Edison Co.	66,000
South Carolina Power Co.	22,500
Southern Wyoming Utilities Co.	7,500
Southwestern Public Service Co.	50,000
Staten Island Edison Corp.	20,000
Texas Electric Service Co.	52,500
Union Electric Co. of Missouri Group	80,000
Wisconsin Electric Power Co.	80,000
Wisconsin Public Service Corp.	30,000
	2,363,500

Municipal and Other Public Plants

Austin, Minn.	7,500
Crawfordsville, Ind.	4,500
Fairbury, Neb.	4,000
Fremont, Neb.	4,000
Glendale, Calif.	20,000
Hastings, Neb.	6,000
Los Angeles, Calif.	69,000
Lansing, Mich.	25,000
Menasha, Wis.	8,000
Moorehead, Minn.	3,000
Richmond, Va.	15,000
	166,000

HYDRO

Power Companies

Consumers Power Co.	650
Holyoke Water Power Co.	250
Idaho Power Co.	16,500
Nantahala Power & Light Co.	2,000
Public Service Co. of New Hampshire	15,000
Southern California Edison Co.	35,000
Union Electric Co. of Missouri Group	1,200
	70,600

Municipal and Other Public Plants

Bureau of Reclamation	333,000
Sanitary District of Chicago	4,000
Tacoma, Wash.	25,000
Tennessee Valley Authority	32,000
	394,000

INTERNAL COMBUSTION

Power Companies

Central Electric & Gas Co.	1,100
Central Kansas Power Co.	2,700
Eastern Shore Public Service Co. of Virginia	1,450
Iowa Electric Light & Power Co.	5,000
Maine Public Service Co.	1,000
Northwestern Public Service Co.	2,272
Montana-Dakota Utilities Co.	5,220
Oklahoma Gas & Electric Co.	1,460
Otter Tail Power Co.	5,000
Pacific Power & Light Co.	1,000
Sioux City Gas & Electric Co. and Iowa Public Service Co.	4,500
Utah Power & Light Co.	1,120
	31,822

Municipal and Other Public Plants

Consumers Public Power District, Neb.	1,000
	1,000

Kind of Power	Private Companies	Municipal and Federal	Total
Steam	2,363,500	166,000	2,529,500
Hydro	70,600	394,000	464,600
Int. Comb.	31,822	1,000	32,822
Totals	2,465,922	561,000	3,027,922

GENERATING CAPACITY TO BE ADDED IN 1948 AND LATER

STEAM

Power Companies	Kw. (Nameplate)
Alabama Power Co.	120,000
Alpena Power Co.	2,500
Arkansas Power & Light Co.	35,000
Boston Edison Co.	81,250
Carolina Power & Light Co.	40,000
Central Illinois Public Service Co.	50,000
Central Illinois Light Co.	35,000
Central Kansas Power Co.	65,000
Central Louisiana Electric Co.	15,000
Central Power & Light Co.	50,000
Cincinnati Gas & Electric Co. Group	100,000
Cleveland Electric Illuminating Co.	75,000
Columbus & Southern Ohio Electric Co.	30,000
Connecticut Light & Power Co.	40,000
Consolidated Edison Co. of N. Y.	220,000
Consolidated Gas, Electric Light & Power Co. of Baltimore	60,000
Consumers Power Co.	120,000
Dallas Power & Light Co.	30,000
Dayton Power & Light Co.	100,000
Detroit Edison Co.	100,000
Duke Power Co.	65,000
Eastern Shore Public Service Co. of Maryland	15,000

El Paso Electric Co.	20,000
Florida Power Corp.	30,000
Florida Power & Light Co.	40,000
Georgia Power Co.	145,000
Gulf Power Co.	22,500
Gulf States Utilities Co.	40,000
Houston Lighting & Power Co.	88,000
Indianapolis Power & Light Co.	40,000
Interstate Power Co. Group	25,000
Iowa-Illinois Gas & Electric Co.	40,000
Jersey Central Power & Light Co.	40,000
Kansas Gas & Electric Co.	25,000
Kentucky Utilities Co.	25,000
Lake Superior District Power Co.	15,000
Long Island Lighting Co.	40,000
Madison Gas & Electric Co.	20,000
Maine Public Service Co.	5,000
Minnesota Power & Light Co.	30,000
Mississippi Power Co.	22,500
Mississippi Power & Light Co.	30,000
Mississippi Valley Public Service Co.	15,000
Missouri Power & Light Co.	7,500
Missouri Public Service Co.	7,500
Monongahela Power Co.	50,000
Montana Power Co.	56,000
New England Gas & Electric System Cos.	15,000
New England Power System Cos.	45,000
New Jersey Power & Light Co.	40,000
New Orleans Public Service Co.	42,500
New York State Electric & Gas Co.	30,000
Niagara Hudson Power Corp.	160,000
Northern States Power Co.	102,500
Northwestern Public Service Co.	7,500
Ohio Edison Co.	55,000
Ohio Power Co.	100,000
Oklahoma Gas & Electric Co.	70,000
Pacific Gas & Electric Co.	190,000
Pacific Power & Light Co.	200,000
Pennsylvania Electric Co.	60,000
Pennsylvania Power Co.	35,000
Pennsylvania Power & Light Co.	150,000
Philadelphia Electric Co. Group	282,500
Potomac Edison Co. Group	35,000
Potomac Electric Power Co. Group	80,000
Public Service Co. of Colorado	35,000
Public Service Electric & Gas Co.	200,000
Public Service Co. of Indiana	35,000
Public Service Co. of New Hampshire	20,000
Public Service of New Mexico	15,000
Public Service Co. of Oklahoma	15,000
Rochester Gas & Electric Co.	40,000
Sioux City Gas & Electric Co. Group	15,000
Southern California Edison Co.	198,000
Southern Colorado Power Co.	15,000
Southern Indiana Gas & Electric Co.	20,000
Southwestern Public Service Co.	35,000
Texas Electric Service Co.	12,500
Union Electric Co. of Missouri Group	80,000
Tampa Electric Co.	30,000
United Illuminating Co.	48,000
Virginia Electric & Power Co.	60,000
West Penn Power Co. Group	80,000
Wisconsin Electric Power Co.	80,000
Wisconsin Power & Light Co.	25,000
Wisconsin Public Service Corp.	50,000
	4,956,250

Municipal and Other Public Plants

Colorado Springs, Colo.	10,000
Consumers Public Power District, Neb.	2,500
Detroit, Mich.	40,000
Frankfort, Ind.	10,000
Glendale, Calif.	70,000
Grand Island, Neb.	10,000
Hagerstown, Md.	5,000
Imperial Irrigation District	20,000
Lakeland, Fla.	15,000
Lansing, Mich.	25,000
Los Angeles, Calif.	180,000
Loup River Public Power District, Neb.	60,000
McPherson, Kan.	7,500
Moorhead, Minn.	5,000
Norwich, Conn.	7,500
Ottawa, Kan.	7,500
Pasadena, Calif.	35,000
Sanitary District of Chicago	10,000
San Antonio, Tex.	25,000
Springfield, Ill.	20,000
Vineland, N. J.	5,000
Virginia, Minn.	5,000
Wyandotte, Mich.	7,500
	582,500

HYDRO

Power Companies

Alabama Power Co.	22,000
California Oregon Power Co.	25,000
Central Maine Power Co.	16,800
Central Vermont Public Service Co.	5,000
Idaho Power Co.	68,500
New England Power System Cos.	30,000
Niagara Hudson Power Corp.	34,000
Pacific Gas & Electric Co.	91,200
Pacific Power & Light Co.	82,700
Public Service Co. of New Hampshire	13,500
	388,700

Municipal and Other Public Plants

Bureau of Reclamation	965,600
Corps of Engineers, U. S. A.	121,000
Seattle, Wash.	60,000
Tennessee Valley Authority	234,800
	1,381,400

INTERNAL COMBUSTION

Power Companies

Eastern Shore Public Service Co. of Virginia	1,000
Otter Tail Power Co.	5,000
Sioux City Gas & Electric Co. Group	3,375
Southwestern Public Service Co.	300
	9,675

Municipal and Other Public Plants

Consumers Public Power District, Neb.	1,000
Hudson, Mass.	3,000
Rockville Center, N. Y.	3,000
	7,000

Kind of Power	Private Companies	Municipal and Federal	Total
Steam	4,956,250	582,500	5,538,750
Hydro	388,700	1,381,400	1,770,100
Int. Comb.	9,675	7,000	16,675
Totals	5,354,625	1,970,900	7,325,525

NUMBER AND INSTALLED CAPACITY OF ELECTRIC UTILITY GENERATING PLANTS BY STATES AND TYPES OF PRIME MOVER

Preliminary as of November 1, 1946

Division and State	Number of Utilities	Number of Plants	Total Capacity Kilowatts	Generator Capacity in Kilowatts of Plants Operated by [a]					
				Water Power		Steam Power		Internal Combustion Engines	
				Number	Capacity	Number	Capacity	Number	Capacity
United States	[b] 1,653	[a] 3,858	50,195,889	1,500	14,839,584	1,049	34,242,655	1,309	1,113,650
New England	106	313	3,196,078	222	895,422	66	2,278,285	25	22,371
Maine	21	83	332,290	63	246,517	7	82,240	13	3,533
New Hampshire	11	56	305,201	48	235,691	5	67,930	3	1,580
Vermont	20	70	174,564	62	160,322	6	13,550	2	692
Massachusetts	37	67	1,329,292	30	162,922	32	1,155,125	5	11,245
Rhode Island	6	10	282,921	4	3,250	5	279,450	1	221
Connecticut	11	27	771,810	15	86,720	11	679,990	1	5,100
Middle Atlantic	116	366	10,514,358	200	1,590,785	136	8,884,482	30	39,091
New York	57	219	5,394,009	162	1,160,110	44	4,208,400	13	25,499
New Jersey	14	25	1,548,947	3	7,270	17	1,537,740	5	3,937
Pennsylvania	45	122	3,571,402	35	423,405	75	3,138,342	12	9,655
East North Central	310	669	11,568,113	292	738,228	244	10,690,528	133	139,357
Ohio	67	104	3,252,791	6	11,525	77	3,223,209	21	18,057
Indiana	54	82	1,610,419	21	35,444	46	1,553,135	15	21,840
Illinois	61	95	3,110,636	12	49,414	60	3,037,289	23	23,933
Michigan	64	198	2,384,651	131	364,831	29	1,970,225	38	49,595
Wisconsin	64	190	1,209,616	122	277,014	32	906,670	36	25,932
West North Central	485	881	3,502,059	135	562,256	216	2,528,717	530	411,086
Minnesota	81	160	758,462	45	126,273	48	572,574	67	59,615
Iowa	96	183	779,948	32	132,926	48	542,035	103	104,987
Missouri	74	115	820,248	6	150,525	30	603,318	79	66,405
North Dakota	16	41	101,213	.....	.....	17	89,338	24	11,875
South Dakota	45	76	100,523	5	3,425	11	60,862	60	36,236
Nebraska	87	169	418,849	40	142,370	28	219,110	101	57,369
Kansas	86	137	522,816	7	6,737	34	441,480	96	74,599
South Atlantic	146	386	6,574,105	159	2,221,098	120	4,262,915	107	90,092
Delaware	6	8	38,862	.....	.....	4	33,150	4	5,712
Maryland	13	30	900,365	3	271,325	14	619,525	13	9,515
District of Columbia	2	3	458,000	1	3,000	2	455,000	.....	.....
Virginia	25	66	792,448	37	182,034	15	598,255	14	12,159
West Virginia	11	35	960,305	11	100,940	14	854,610	10	4,755
North Carolina	29	77	1,351,453	48	657,570	19	681,721	10	12,162
South Carolina	15	43	791,869	28	650,644	9	136,730	6	4,495
Georgia	14	46	715,026	27	342,892	14	369,900	5	2,234
Florida	31	78	565,777	4	12,693	29	514,024	45	39,060
East South Central	62	135	3,427,679	39	2,221,440	58	1,188,459	38	17,780
Kentucky	16	32	579,716	4	238,860	23	338,701	5	2,155
Tennessee	16	39	1,451,633	23	1,023,017	11	426,950	5	1,666
Alabama	6	29	1,326,633	12	959,563	10	363,240	7	3,830
Mississippi	24	35	69,697	.....	.....	14	59,568	21	10,129
West South Central	179	396	2,709,353	36	370,847	95	2,112,951	265	225,555
Arkansas	24	41	222,845	6	102,008	13	102,845	22	17,992
Louisiana	37	60	541,983	.....	.....	10	494,520	50	47,463
Oklahoma	52	101	457,718	4	59,224	22	343,426	75	55,068
Texas	66	194	1,486,807	26	209,615	50	1,172,160	118	105,032
Mountain	180	415	2,675,846	199	2,004,004	66	559,088	150	112,754
Montana	20	39	373,431	22	358,274	4	11,968	13	3,189
Idaho	15	53	268,718	43	265,196	1	400	9	3,122
Wyoming	28	49	82,419	15	49,520	10	27,160	24	5,739
Colorado	41	85	332,849	30	86,585	24	228,648	31	17,616
New Mexico	23	47	177,467	6	25,090	13	127,487	28	24,890
Arizona	18	52	679,368	15	540,759	10	94,675	27	43,934
Utah	27	75	171,437	58	92,445	4	68,750	13	10,242
Nevada	8	15	590,157	10	586,135	.....	.....	5	4,022
Pacific	69	297	6,028,298	218	4,235,504	48	1,737,230	31	55,564
Washington	23	62	1,738,625	45	1,534,280	10	202,320	7	2,025
Oregon	20	71	904,666	51	713,029	12	186,810	8	4,827
California	26	164	3,385,007	122	1,988,195	26	1,348,100	16	48,712

Notes: [a] For the approximately 180 combination plants each type of prime mover is counted as a separate plant.
[b] Total includes 85 duplications because of utilities having generating plants in more than one state.

Source: Federal Power Commission.

Maintenance

$260,033,000

COST of keeping electricity supply systems in good operating condition is going up. Estimated nation-wide averages of maintenance expense per kilowatt of installed generating capacity are $4.47 in 1945, $4.63 in 1946, and $5.10 in 1947.

Other evidence of increased maintenance cost comes from examination of 99 reports to ELECTRICAL WORLD on rise of this cost since the war. These reports show a median value of 30 percent increase, occurring 10 times. Most frequent occurrence was 25 percent, 18 times. Maximum and minimum estimates were 70 and 10 percent, each occurring once. These percentages indicate higher future costs than do tabulated figures.

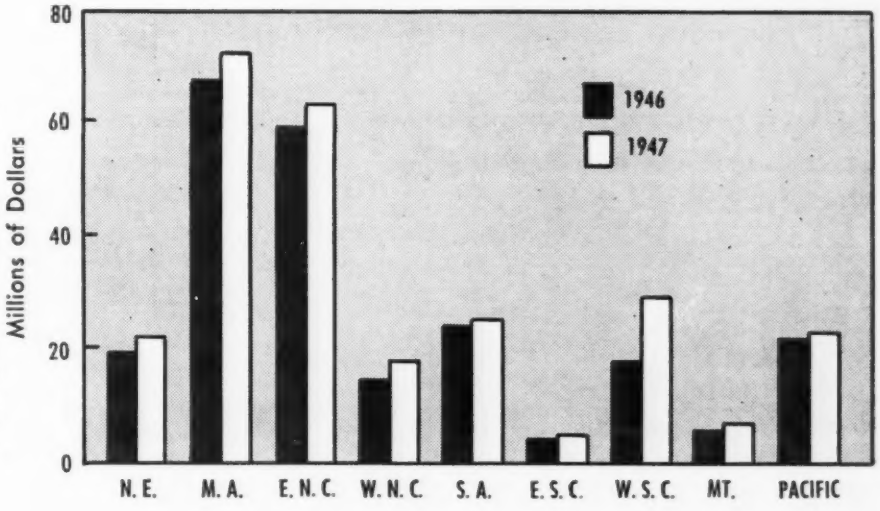
Distribution system and steam power plant get the two largest shares of the maintenance dollar, 47.6 and 34 cents respectively, according to the table at the bottom of this page. (This table is not comparable with the one at the left because the bases of reporting are different.) Transmission gets 9.4 cents and hydraulic power plant 5.3.

MAINTENANCE EXPENDITURES, 1947

(Thousands of Dollars)

Regions	1946	1947*
New England	19,061	21,748
Middle Atlantic	67,050	71,080
E. N. Central	58,410	62,880
W. N. Central	14,840	17,210
South Atlantic	23,480	24,480
E. S. Central	4,350	4,760
W. S. Central	17,535	28,835
Mountain	5,640	6,280
Pacific	21,855	22,260
United States	232,221	260,033

Source: "Electrical World" Surveys.
* Estimated.



MAINTENANCE EXPENDITURES

Privately Owned Class A and B Electric Utilities in The United States

(In Thousands of Dollars)

Plant Accounts	1938	1939	1940	1941	1942	1943	1944	1945	Total	Percent
Steam Power	31,511	33,240	36,222	40,397	44,775	53,258	72,825	79,751	391,979	34.0
Hydraulic Power	6,192	5,985	5,995	6,369	6,152	7,955	10,583	12,033	61,264	5.3
Int. Comb. Eng. Power	622	659	731	702	759	809	1,020	1,116	6,519	0.6
Transmission	11,689	10,487	11,298	12,215	13,456	14,921	16,151	16,753	106,970	9.4
Distribution	62,604	62,027	63,789	65,446	66,108	69,624	76,700	79,416	547,714	47.6
General Properties	3,452	4,101	4,110	4,091	4,023	4,473	5,243	6,445	35,738	3.1
Total	116,070	116,499	122,145	129,220	135,273	151,040	182,522	195,514	1,150,184	100

Source: Federal Power Commission.

Station Economics

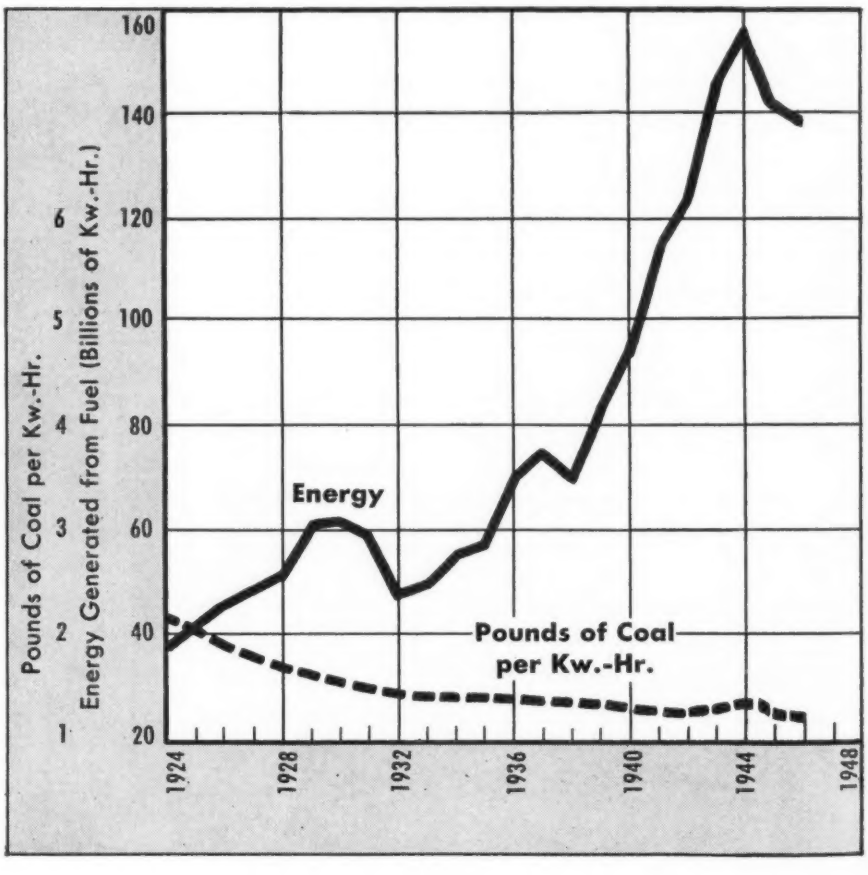
1.29 pounds of coal per kw.-hr.

DESPITE several adverse factors, the electric power industry as a whole for the first time generated a kilowatt-hour for less than 1.30 lb. of coal or its equivalent in gas or oil. The year's figure is 1.29 lb. and it signifies the success of many moves which unite to improve the thermodynamic efficiency of the conversion from fuel to electrical energy.

Contributing also to the improved fuel economy were the larger output per unit of fuel power capacity and the replacement of old by new generating equipment during the year.

Among the adverse factors which make the resumed downward trend doubly significant were the two coal strikes, the railroad and other strikes well distributed in effect over the nation, and a noticeable deepening of the holiday load valleys.

OUTPUT FROM FUEL AND FUEL USED



Hours of operation of installed capacity were greater (by 13.5 percent) than in any pre-war year and only 3.5 percent behind the war-stimulated activity of 1944. For a more recent comparison, hours used of installed capacity in 1946 outdid those of 1945 by a fraction of a percent and most of that betterment in productivity is attributable to the sharply rising output of the late summer and fall months.

It was again a good hydro year but not quite as good in terms of hours over which units could take water from behind the dams as 1943 and 1945 had been. Steam units in 1946 were carrying full load more hours than any year except 1942 and 1943; the hours were 2.5 percent greater than in 1945.

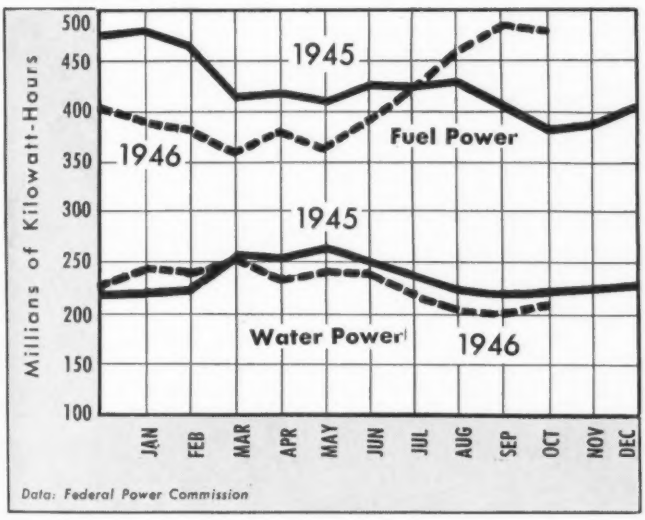
What with good hydro and the thermal efficiency gains from the better heat cycles, better equipment, higher pressures and temperatures and better control of steam generation, the electric utilities bought 5 percent less

OUTPUT, CAPACITY, AVERAGE USE

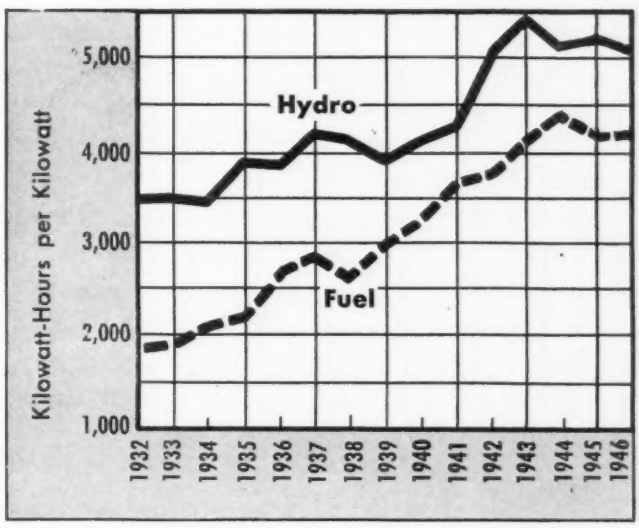
Year	Energy Generated (Millions of Kw.-Hr.)			Generating Capacity at end of year (Thousands of Kw.)			Output per Kw. of Ave. Cap. (Kw.-Hr.)		
	Fuel	Water	Total	Fuel	Water	Total	Fuel	Water	Total
1933	50,678	34,058	84,736	26,507	9,736	36,243	1,915	3,526	2,346
1934	57,093	33,713	90,806	26,049	9,742	35,791	2,173	3,462	2,521
1935	59,430	39,034	98,464	26,279	9,795	36,074	2,271	3,996	2,740
1936	72,665	39,516	112,181	26,128	10,436	36,564	2,773	3,906	3,089
1937	77,348	44,489	121,837	26,558	10,577	37,135	2,936	4,234	3,306
1938	71,847	44,834	116,681	27,976	11,066	39,042	2,635	4,143	3,063
1939	86,314	44,022	130,336	28,903	11,415	40,318	3,035	3,916	3,285
1940	97,232	47,753	144,985	29,964	11,675	41,639	3,303	4,137	3,538
1941	116,908	51,262	168,170	31,828	12,264	44,092	3,784	4,283	3,923
1942	125,002	64,179	189,181	33,381	13,025	46,407	3,834	5,076	4,181
1943	147,027	73,943	220,970	35,237	14,068	49,305	4,285	5,458	4,617
1944	156,704	74,032	230,736	35,671	14,604	50,275	4,392	5,164	4,634
1945	142,516	79,970	222,486	35,199	14,912	50,111	4,021	5,419	4,433
1946	145,380	77,954	223,334	35,356	14,840	50,196	4,121	5,240	4,453

Source: Federal Power Commission. * Energy generated estimated for full year; generating capacity to November 1.

AVERAGE DAILY PRODUCTION



AVERAGE USE OF CAPACITY



coal than in 1945. Some of this decrease is however, also attributable to a 53 percent increase in resort to oil for fuel; gas used was down nearly 8 percent. Oil and gas combined represent about one-fifth of the total heat units used to produce electricity.

Oil and gas 13 years ago (1933) together contributed 17.8 percent of the electric power systems' thermal requirements; in 1946 it was 19.3 percent. Their greatest year was 1939 when their joint share was 22.3 percent of the total heat units.

Coal equivalents of oil and gas in 1946 were 5.93 and 4.18 million tons respectively, figured as 3.98 bbl. of oil and 25,490 cu. ft. of gas equal to a ton of coal.

OUTPUT FROM FUEL AND FUEL USED

Year	Energy Generated from Fuel † (Millions of Kw.-Hr.)	Fuel Consumed				
		Coal (Millions of Tons)	Oil (Millions of Bbl.)	Gas (Billions of Cu. Ft.)	†† Coal Equiv. (Millions of Tons)	Pounds of Coal per Kw.-Hr.†
1935	59,176	34.81	11.39	125.24	43.20	1.46
1936	72,188	42.03	14.12	156.08	51.99	1.44
1937	76,883	44.77	14.14	171.27	55.14	1.43
1938	71,525	40.21	13.08	170.69	50.56	1.41
1939	85,800	46.22	17.42	191.13	59.51	1.39
1940	96,609	53.40	16.77	183.16	65.14	1.35
1941	116,167	64.76	20.25	205.16	77.99	1.34
1942	124,401	68.42	15.28	238.74	81.44	1.31
1943	146,615	79.67	18.04	305.59	95.70	1.31
1944	156,328	82.31	20.87	359.77	103.92	1.33
1945	142,331	74.73	20.23	326.21	92.76	1.30
1946*	139,345	70.16	31.17	303.18	89.49	1.29

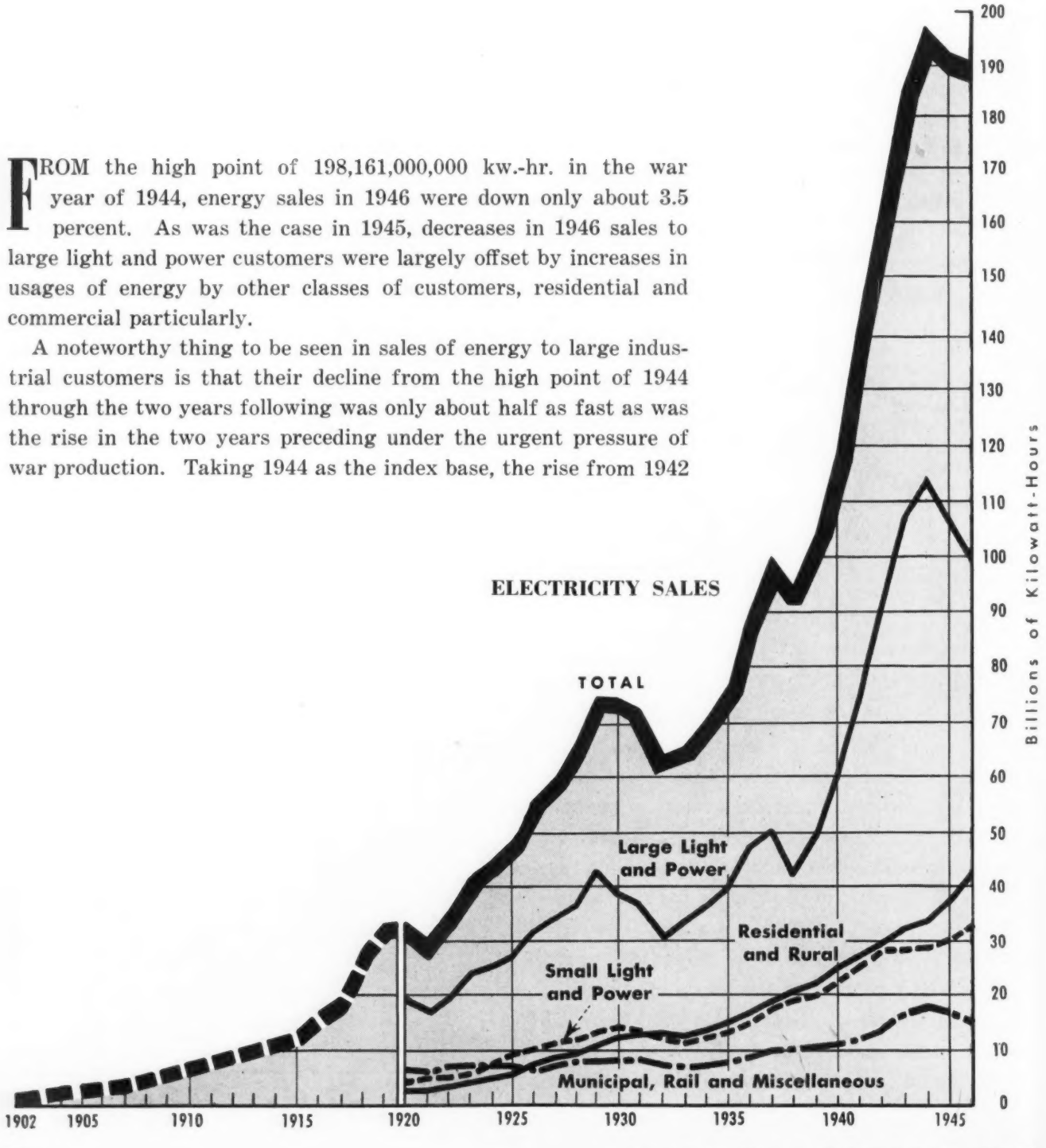
Source: Federal Power Commission. * Twelve months ended October 31. † Output by use of wood not included except for small amount in 1946 estimate. †† Coal plus oil plus gas.

Energy Sales

191,000,000,000 kw.-hr.

FROM the high point of 198,161,000,000 kw.-hr. in the war year of 1944, energy sales in 1946 were down only about 3.5 percent. As was the case in 1945, decreases in 1946 sales to large light and power customers were largely offset by increases in usages of energy by other classes of customers, residential and commercial particularly.

A noteworthy thing to be seen in sales of energy to large industrial customers is that their decline from the high point of 1944 through the two years following was only about half as fast as was the rise in the two years preceding under the urgent pressure of war production. Taking 1944 as the index base, the rise from 1942



was 24.5 percent, while the decline to 1946 was only 13.4 percent. This is the more remarkable in consideration of the industrial disturbances since the war and is solid evidence that with such disturbances minimized, industrial activity will greatly expand.

In billions of kilowatt-hours, the parade of figures of sales of electricity to residential customers as shown in the table on this page is most impressive. Beginning with 1933 through 1946 they march with growing speed—11, 12, 13, 15, 18, 19, 21, 23, 25, 27, 29, 31, 34, 38. The 14-year period includes a distinct recession in business activity—1938—and four years of war in which manufacture of household electric appliances was discontinued. Part of the reason for this phenomenon is certainly an increasing usage of electricity for domestic purposes per unit of population. And part of it lies in another cause, lack of adequate housing.

Whatever may be the major cause, the fact remains that people are buying more electricity for use in their homes. In 1946, the average annual kw.-hr. per residential customer rose from 1,229 to 1,327, the largest increase in the record of the industry.

Sales of electricity to small light and power customers, commercial establishments mostly, in 1946 show a resumption of increase that was interrupted by the war. In 1941 and 1942 the annual increases over the previous years were respectively 2.3 and 2.6 billion kw.-hr. The increase dropped to one billion in 1943, rose to 1.6 in 1944, dropped again in 1945 to 0.6 billion and then came back to 2.5 in 1946.

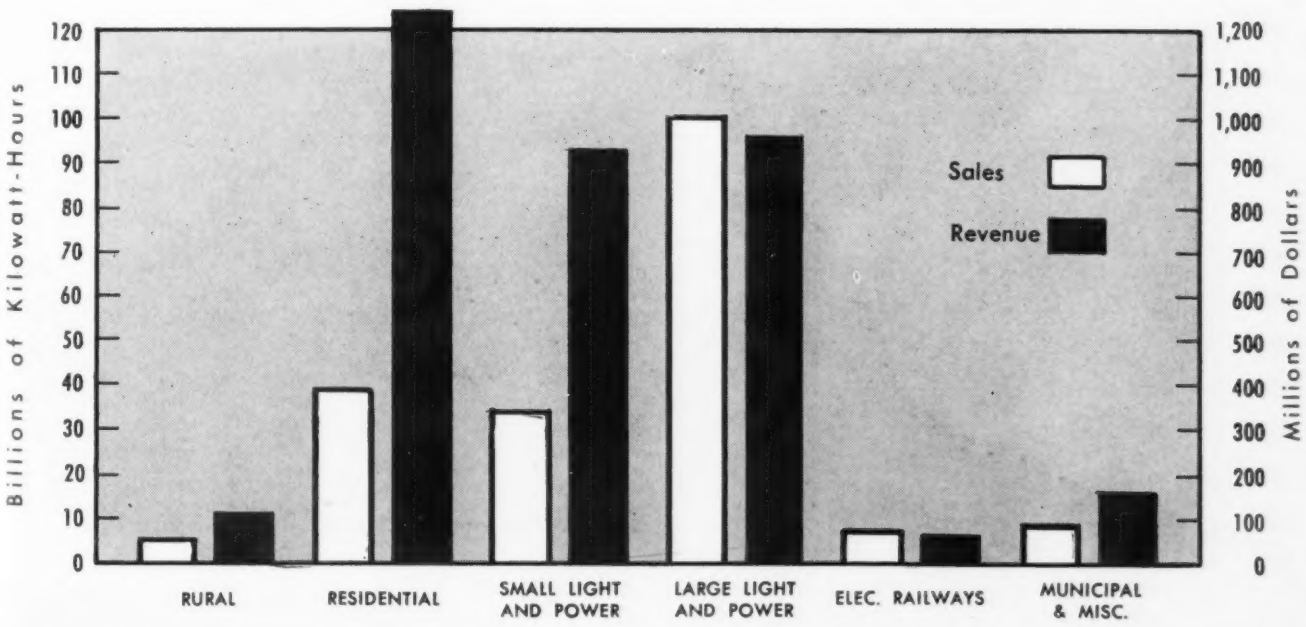
ENERGY SALES TO ULTIMATE CONSUMERS

(In Millions of Kw.-Hr.)

Year	Rural	Residential	Small Light and Power	Large Light and Power	Street and Highway Lighting	Street and Interurban Electric Railways	Electrified Divisions of Steam Railroads	Municipal and Miscellaneous	Total to Ultimate Consumers
1933	1,633	11,358	11,589	33,857	1,893	3,991	668	927	65,916
1934	1,858	12,233	12,278	36,943	1,896	4,237	692	945	71,082
1935	1,693	13,496	13,588	40,864	2,078	4,194	841	842	77,596
1936	2,138	14,992	15,612	48,655	2,223	4,401	1,115	908	90,044
1937†	1,670	17,691	18,075	51,360	1,863	4,428	1,284	2,987	99,359
1938	1,577	19,371	19,137	43,140	1,929	3,989	1,449	3,138	93,731
1939	1,881	21,084	20,722	51,108	2,002	3,918	1,847	3,205	105,768
1940	1,991	23,318	22,373	59,557	2,048	3,974	1,935	3,447	118,643
1941	2,352	25,124	24,628	76,060	2,111	3,960	2,118	3,707	140,060
1942	2,890	26,937	27,234	88,378	2,061	4,256	2,372	5,280	159,408
1943	2,996	28,621	28,192	106,657	2,075	4,696	2,530	10,122	185,889
1944	3,373	31,266	29,837	115,187	2,163	4,635	2,694	9,006	198,161
1945	3,668	34,184	30,438	107,490	2,184	4,683	2,671	8,240	193,558
1946*	4,475	38,400	32,925	99,600	2,250	4,525	2,625	6,200	191,000

Source: Edison Electric Institute. * Estimated. † Revised figures to conform with Uniform System of Accounts prescribed by Federal Power Commission from 1937.

ENERGY SALES BY CLASSES OF CONSUMERS, 1946

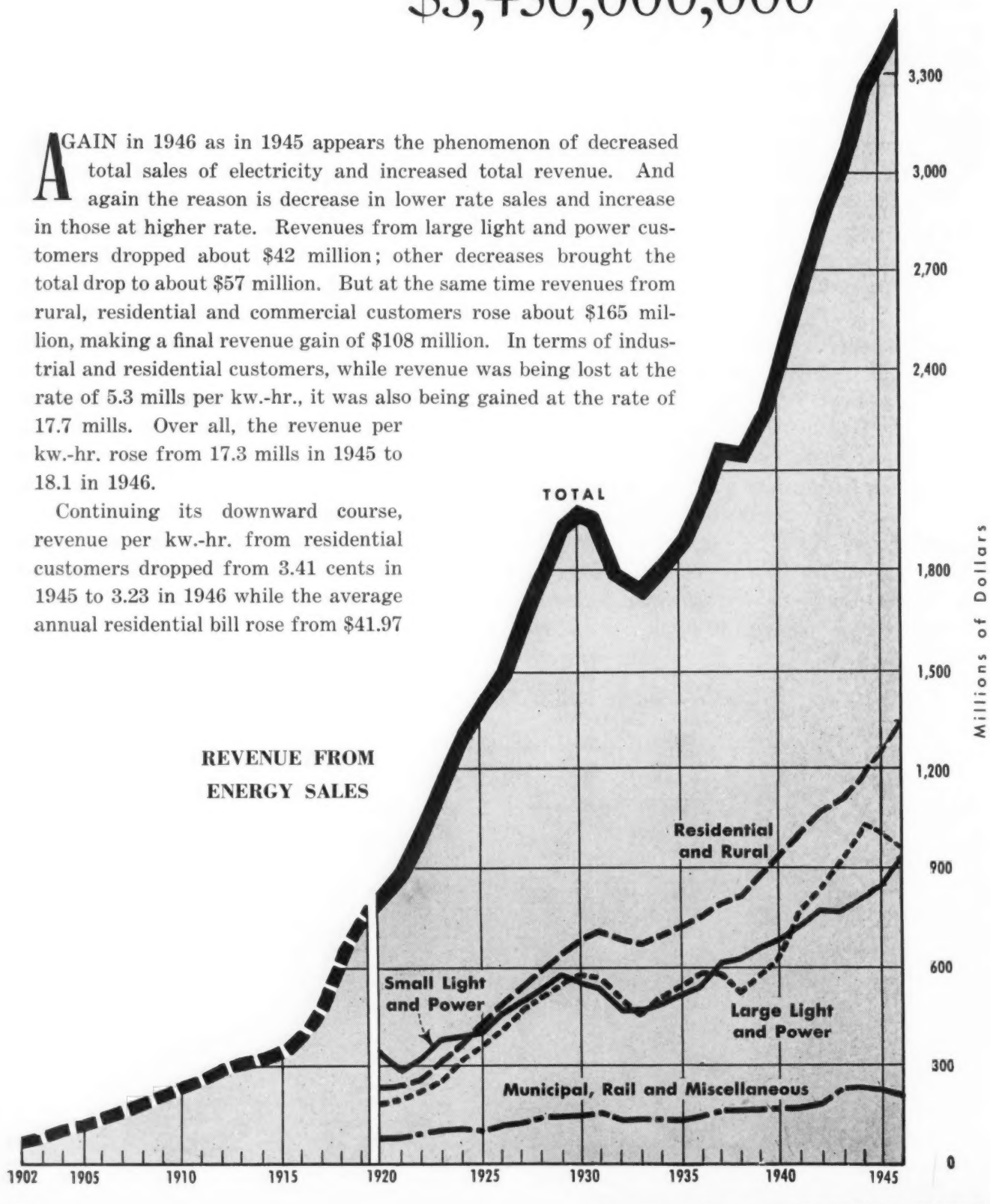


Revenue

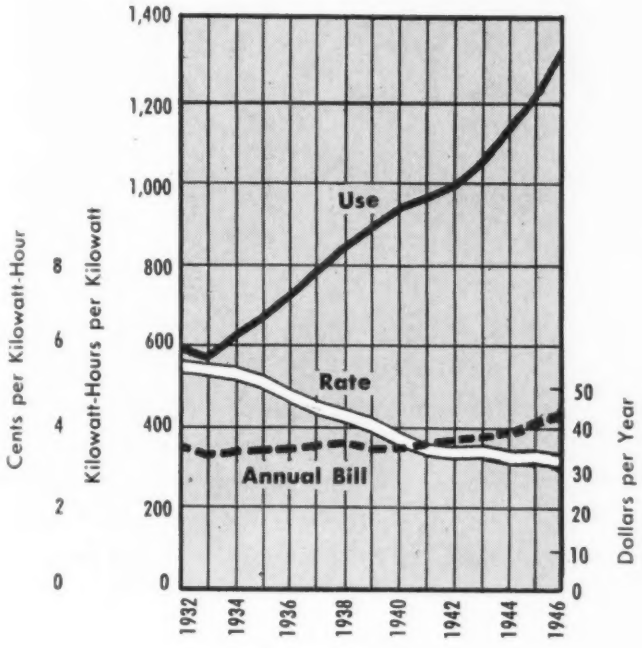
$3,450,000,000

AGAIN in 1946 as in 1945 appears the phenomenon of decreased total sales of electricity and increased total revenue. And again the reason is decrease in lower rate sales and increase in those at higher rate. Revenues from large light and power customers dropped about $42 million; other decreases brought the total drop to about $57 million. But at the same time revenues from rural, residential and commercial customers rose about $165 million, making a final revenue gain of $108 million. In terms of industrial and residential customers, while revenue was being lost at the rate of 5.3 mills per kw.-hr., it was also being gained at the rate of 17.7 mills. Over all, the revenue per kw.-hr. rose from 17.3 mills in 1945 to 18.1 in 1946.

Continuing its downward course, revenue per kw.-hr. from residential customers dropped from 3.41 cents in 1945 to 3.23 in 1946 while the average annual residential bill rose from $41.97



AVERAGES FOR RESIDENTIAL SERVICE



RESIDENTIAL SERVICE TO URBAN AND NON-FARM HOMES

Year	Kw.-Hr. per Customer	Average Annual Bill (Dollars)	Revenue per Kw.-Hr. (Cents)
1934	624	33.07	5.30
1935	672	33.53	4.99
1936	727	33.81	4.65
1937	805	34.62	4.30
1938	853	35.31	4.14
1939	897	35.88	4.00
1940	952	36.56	3.84
1941	986	36.78	3.73
1942	1,012	37.51	3.67
1943	1,070	38.50	3.60
1944	1,151	40.40	3.51
1945	1,229	41.97	3.41
1946*	1,327	42.93	3.23

Source: Edison Electric Institute. * Estimated.

to $42.93. For this increase of 96 cents in his bill the average residential customer received an additional 98 kw.-hr. On this incremental basis his increased usage cost him less than one cent per kw.-hr.

A contributing factor to the increases in revenue from rural, residential and commercial customers is the increase in numbers of these customers that occurred in 1946. In general, it may be said that new customers use less electricity than do older ones because it takes time for them to obtain equipment and appliances and to learn what electricity can do for them. Thus the bills of these customers are at first quite largely in the higher brackets of rate schedules and a new customer adds more to revenue than the average of established users of service.

The drop in revenue, 1945-1946, of around $700,000 from street and highway lighting, accompanied as it was by an increase in energy used for this service, probably indicates lower rates offered in effort to develop the load. In 1945 the average revenue per kw.-hr. for street lighting was 3.5 cents, in 1946, 3.3 cents.

REVENUE FROM ELECTRICITY SALES

(Thousands of Dollars)

Year	Rural‡	Residential	Small Light and Power	Large Light and Power	Street and Highway Lighting	Street and Interurban Electric Railways	Electrified Divisions of Steam Railroads	Municipal and Miscellaneous	Total from Ultimate Consumers
1933	46,501	623,797	471,780	468,389	83,097	35,098	6,658	19,243	1,754,366
1934	49,182	648,801	490,420	499,451	81,846	36,402	6,680	19,085	1,831,870
1935	48,404	673,526	519,213	531,106	79,429	36,431	7,944	15,933	1,911,988
1936	59,286	696,997	562,122	581,148	80,791	37,423	9,591	17,225	2,044,586
1937†	37,726	759,824	616,438	583,197	72,740	37,019	10,761	43,091	2,160,798
1938†	38,928	802,532	632,091	518,694	74,323	33,512	11,995	44,504	2,156,580
1939†	45,484	843,158	660,683	572,659	75,443	32,573	14,427	45,154	2,289,583
1940†	49,473	895,951	689,253	631,428	76,052	32,740	15,068	50,252	2,440,218
1941	64,396	938,229	725,117	758,083	76,919	32,471	16,474	53,338	2,665,057
1942	75,027	990,185	767,279	828,318	75,660	35,343	18,289	65,742	2,885,843
1943	76,617	1,029,260	769,490	968,378	75,384	38,278	19,820	100,415	3,077,643
1944	82,842	1,097,726	817,355	1,043,392	76,626	38,672	21,602	98,537	3,276,752
1945	90,344	1,167,356	850,213	1,001,957	76,189	39,787	21,677	93,995	3,341,518
1946*	105,000	1,242,000	925,000	960,000	75,500	38,500	20,300	81,700	3,450,000

Source: Edison Electric Institute. * Estimated. † Uniform System of Accounts prescribed by Federal Power Commission begins new series of figures in 1937. ‡ Specific rural rates only.

Customers

record increase in 1946

MORE CUSTOMERS were added to electric utility lines in 1946 than in any previous year of the industry's history. The rate of increase went to 6.1 percent, after 2.6 percent in 1945, which was a remarkable recovery from the low of 0.6 percent of 1943.

Because the table below shows as rural customers only those served on rates specifically designated for rural service, a great many farm and other rural customers are included under the residential classification, being served on urban rates. To get a more accurate picture, the two customer groups should be lumped.

On this basis the number of home users of electricity becomes 31,103,000 in 1946, an increase of 6 percent over the 29,351,439 in 1945.

More than twice as many commercial and industrial customers were added in 1946 as in 1945, 315,778 as against 146,953, the rate of increase jumping from 3.3 to 6.9 percent. This acceleration of growth reflects the removal of restrictions on commercial and industrial activities since the ending of the war.

In 1945, for each commercial and industrial customer added, there were 5.7 rural and residential. The same ratio between the two groups was maintained in 1946. Regionally, the ratio was extremely variable, ranging from a high of 13.9 in the West North Central to a low of 3.9 in the Pacific. The median ratio was in the West South Central, with the New England, Middle Atlantic, East North Central, and Pacific regions below, and the Mountain, East South Central, South Atlantic, and West South Central above. The ratios indicate a more rapid increase in industrial and commercial activity proportionate to population in the regions below the median than in those above.

CENTRAL STATION CUSTOMERS AT END OF YEAR*

	United States	New England	Middle Atlantic	East No. Central	West No. Central	South Atlantic	East So. Central	West So. Central	Mountain	Pacific
Total Customers										
1946	36,100,000	2,795,960	8,551,890	8,221,540	3,403,340	3,751,670	1,767,350	2,632,370	1,096,770	3,879,110
1945	34,031,073	2,631,849	8,250,734	7,827,752	3,196,130	3,465,498	1,605,790	2,385,331	1,016,589	3,651,400
Change	2,068,927	164,111	301,156	393,798	207,210	286,172	161,560	247,039	80,181	227,710
Rural Customers†										
1946	1,360,000	9,100	68,900	370,900	158,600	111,500	98,000	162,000	27,100	353,900
1945	1,234,441	8,437	59,548	339,509	138,880	98,885	77,362	130,610	22,468	358,742
Change	125,559	663	9,352	31,391	19,720	11,615	20,638	31,390	4,632	−4,842
Residential Customers										
1946	29,743,000	2,414,000	7,260,000	6,855,000	2,725,000	3,110,000	1,445,000	2,075,000	905,000	2,954,000
1945	28,116,998	2,275,372	7,022,267	6,559,524	2,560,572	2,875,369	1,322,274	1,893,305	840,492	2,767,823
Change	1,626,002	138,628	237,733	295,476	164,428	234,631	122,726	181,695	64,508	186,177
Commercial & Industrial										
1946	4,876,300	365,000	1,200,000	971,000	508,000	518,000	214,000	384,000	162,000	554,300
1945	4,560,522	340,753	1,146,817	904,120	484,734	480,253	195,776	348,897	151,062	508,110
Change	315,778	24,247	53,183	66,880	13,266	27,747	18,224	35,103	10,938	46,190
Municipal, Rail & Misc.										
1946	120,700	7,860	22,990	24,640	11,740	12,170	10,530	11,370	2,670	16,910
1945	119,112	7,287	22,108	24,559	11,944	10,991	10,378	12,519	2,567	16,725
Change	1,588	573	882	81	−204	1,179	152	−1,149	103	185

* 1946 Estimated. † Customers served on specific rural rates; rural customers served on urban rates not included.

Financial

income and expenses

THE YEAR 1946 witnessed considerable change in the expense and income items that make up the consolidated income statement for electric light and power companies. Gross operating revenue increased only slightly, but a lower tax bill combined with a sharp reduction in capital costs more than offset heavier operating costs. The end result was an advance in net income to a high of $636 million.

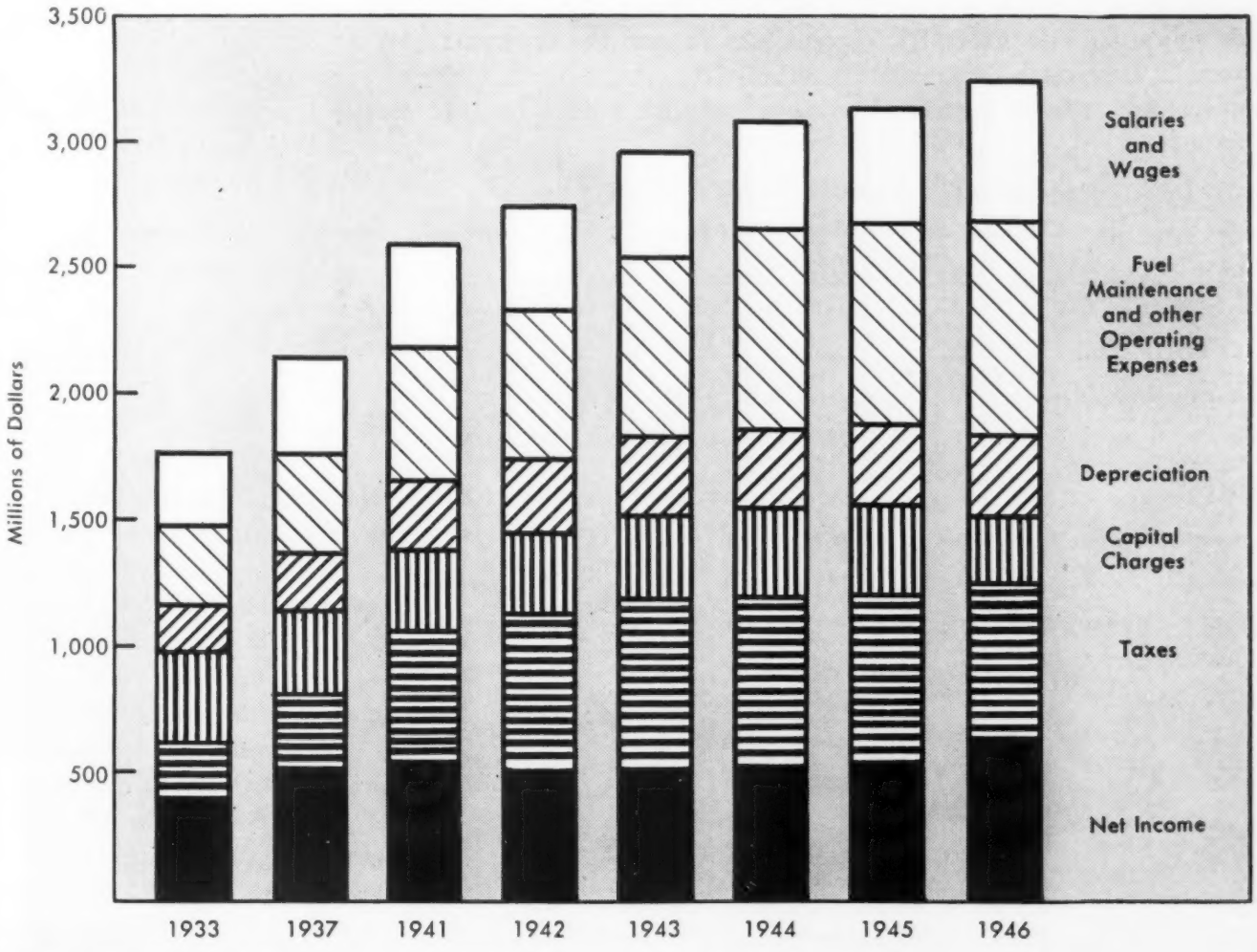
The industry tax bill dropped from $652 million in 1945 to $605 million—excess profits repeal.

Moreover, a wave of refunding substantially lowered capital charges. This item totaled $269 million in 1946, down more than one-fourth from the $360 million in the previous year.

Capital charges are now lower than at any time since 1926. In that year electricity output was about one-third of the 1946 volume. Moreover, the long term debt of the industry in 1926 totaled $5.5 billion, as contrasted with a debt today that is in the neighborhood of $6 billion.

On the other hand, operating expenses have long been moving

DISTRIBUTION OF GROSS REVENUE

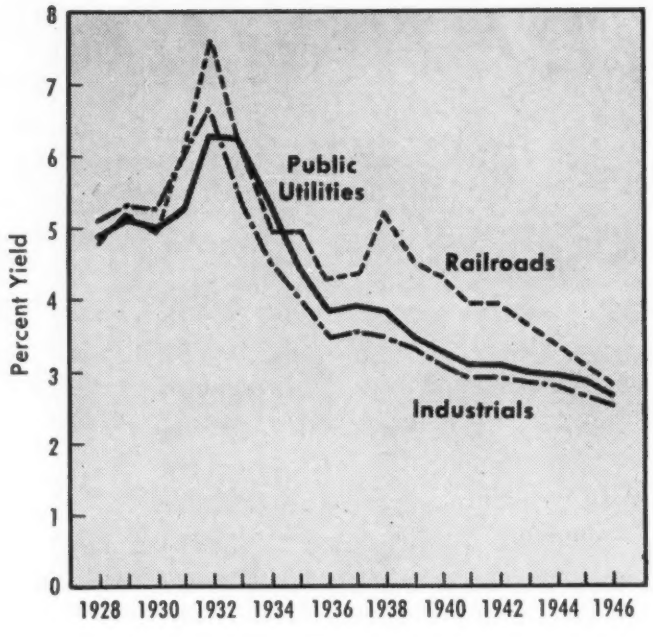


in the opposite direction. And 1946 saw the pace of their advance stepped up, rather than retarded.

The continued increase in wage rates in the electric light and power industry is reviewed at some length in the section on employment and wages. There it is shown that average hourly earnings rose to about $1.27 at the end of 1946, as compared with $1.19 a year earlier. Moreover, the industry restored its working force to more efficient levels, expanding employment from 222,000 to 246,000 even though output was little increased. The result was a boost of 22 percent in the aggregate wage bill. For 1946 this totaled $550 million whereas in 1945 it had amounted to $452 million.

Fuel costs also took a record hop upward. The general advance in wage-rates throughout the economy lifted both the cost of mining and of transporting coal, so that by year end the price to the electric power suppliers had jumped about 20 percent. As a result, the aggregate fuel bill for the industry increased to $424 million, up $41 million from the 1945 total.

COMPARATIVE AVERAGE BOND YIELDS



The great shift in costs during 1946 has of course vastly altered the allocation of the revenue dollar as between various income and expense items. It is of particular interest to examine the change that has occurred in this regard over the past decade.

Distribution of Revenue Dollar

	1936	1941	1946
Fuel	8.1	10.1	13.1
Salaries and Wages	17.5	16.9	17.1
Other Operating expenses	12.1	11.3	13.2
Depreciation	10.3	11.3	9.9
Fixed Charges	18.8	12.6	8.3
Taxes	14.7	21.1	18.7
Dividends and Surplus	18.5	16.7	19.7
	100.0	100.0	100.0

Notwithstanding the fact that average hourly earnings of electric light and power workers have advanced by 55 percent since 1936, the share of the revenue dollar claimed for wages and salaries has changed but little. Meanwhile the proportion flowing to dividends and surplus has declined by more than a tenth.

Altogether the rise in fuel costs, along with the advance in

COMPOSITE INCOME STATEMENT
Electric Light & Power Cos.
(Millions of dollars)

	1937	1941	1944	1945	1946*
Gross Operating Revenue	2,031	2,467	2,955	3,012	3,112
Operating Expenses	781	947	1,225	1,259	1,397
Depreciation	216	279	319	322	321
Total Expenses	997	1,226	1,544	1,581	1,718
Operating Income Before Taxes	1,034	1,241	1,411	1,431	1,394
Taxes	308	520	677	652	605
Operating Income After Taxes	726	721	734	779	789
Other Income	113	128	125	126	116
Gross Income	839	849	859	905	905
Capital Charges	330	312	342	360	269
Net Income	509	537	517	545	636
Of which:					
To Dividends	434	437	398	415	485
To Surplus	75	100	119	130	151

* Estimated.
Source: Federal Power Commission and Edison Electric Institute.

other operating costs, raised the ratio of operating expenses to revenue to a new high of 43.4 percent in 1946. This compares with a ratio of 37.7 percent in 1936 and 38.4 percent in 1941.

Depreciation is one expense that has moved along in step with operating revenue. For although the $321 million chalked up to this account in 1946 is three-fifths more than a decade ago, it continues to be about 10 percent of the operating revenue.

The consolidated balance sheet shows the growth of the depreciation account through the war years. The increase of $1 billion between 1941 and 1945 is about equal to the increase in the value of electric plant and equipment. While the constant revaluation of assets undertaken at the direction of the Federal Power Commission makes any detailed analysis of changes in the consolidated balance sheet impossible, it appears reasonable to assume that expansion of facilities was financed to no small extent from reinvestment of depreciation funds.

This conclusion is further substantiated by examination of the data on sale of securities, set forth in the table at the bottom of the page. New capital issues for the years 1942 through 1945 totaled only $157 million, about 15 percent of the increase in the value of plant and equipment over the same period.

The past year was featured by the heaviest volume of new capital issues to reach the market since 1931. Even so, the total of $172,846,000 was little more than half the charge to depreciation during the year.

Sale of securities for refunding fell behind the record hung up in 1945. Nevertheless, the very large total of $909 million was instrumental in reducing capital costs substantially. The average yield of 33 new issues of mortgage bonds fell to 2.61 percent (average yield in 1945 was 2.77 percent); and the average yield of 25 issues of preferred stock declined to 3.56 percent (average in 1945, 3.86 percent).

COMPOSITE YEAR-END BALANCE SHEET
ELECTRIC UTILITY COMPANIES
(Class A and B)

	Millions of Dollars		
	1945	1944	1941
ASSETS:			
Electric Plant and Adjustments	12,176	11,895	11,071
Gas Plant and Adjustments	1,333	1,316	1,279
Other Utility Plant and Adjustments	491	482	458
Unclassified and Undistributed	491	1,061	1,929
Total Utility Plant	14,491	14,754	14,737
Investment and Fund Accounts	1,089	1,298	1,321
Current and Accrued Assets	1,696	1,679	1,217
Deferred Debits	264	297	422
Capital Stock Discount and Expenses	36	37	42
Reacquired Securities	57	57	56
Total Assets	17,633	18,122	17,795
LIABILITIES:			
Capital Stock	6,062	6,380	6,614
Cash Investment	.....	.....	.....
Long Term Debt	6,141	6,397	6,822
Current and Accrued Liabilities	965	960	808
Reserve for Depreciation and Amortization of Utility Plant	3,065	2,822	2,096
Other Reserves	236	305	215
Deferred Credits	113	99	72
Contributions in Aid of Construction	46	55	47
Surplus	1,005	1,104	1,121
Total Liabilities	17,633	18,122	17,795

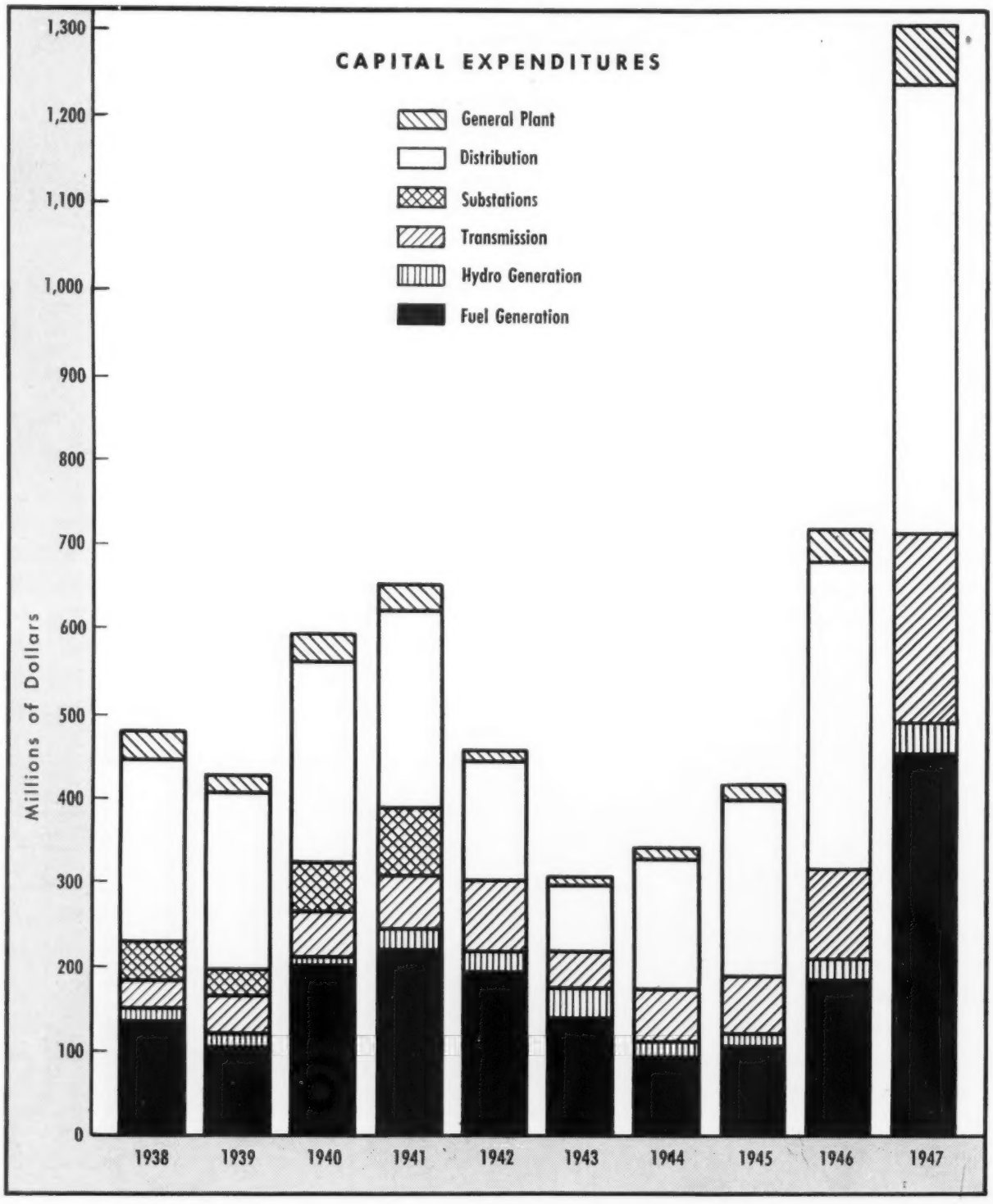
Source — Federal Power Commission.

Security Sales by Classes
(In Thousands of Dollars)

Year	Bonds, Debentures, etc., to		Stocks, Common and Pfd.	Total Financing	Distribution of Security Sales		
	Public Investors	Institutional Investors			New Capital	Refunding	Total Issues
1932	404,840	Included	65,417	470,257	165,728	239,112	404,840
1933	53,725	in	2,523	56,248	6,813	46,913	53,725
1934	131,175	Col. 1	.....	131,175	2,431	128,744	131,175
1935	957,042	110,629	8,229	1,075,900	26,496	1,049,404	1,075,900
1936	1,122,800	156,881	52,259	1,331,940	59,727	1,272,213	1,331,940
1937	522,613	37,604	86,095	646,312	81,984	563,699	645,682
1938	750,549	192,762	20,694	964,005	123,056	840,949	964,005
1939	620,205	252,625	123,517	996,347	16,219	980,128	996,347
1940	660,716	188,976	139,767	989,459	92,376	897,083	989,459
1941	368,712	255,912	116,208	740,832	97,065	643,767	740,832
1942	226,800	99,688	29,766	356,254	92,666	263,588	356,254
1943	329,300	26,850	14,912	371,062	9,921	361,141	371,062
1944	851,743	103,950	62,535	1,018,228	15,587	1,002,641	1,018,228
1945	1,113,603	121,051	127,268	1,361,922	39,699	1,322,253	1,361,922
1946	633,966	64,040	384,441	1,082,447	172,846	909,601	1,082,447

Budget

rises to $1,400,000,000



RISING FAR above the highest previous year—$919,000,000 in 1930—electric utility construction expenditures estimated for 1947 reach the amazing total of $1,307,299,000. Adding to this an estimated $91,000,000 for federal construction of electricity production facilities, the figure rises to nearly $1,400,000,000, half a billion above the previous high.

In general, expenditure estimates last year were based on a lower price level than is the case for 1947. The price rise appears to be of the order of 30 percent across the board. Included in the report form used for the expenditures survey were requests for estimates of construction cost increases since the war. A summary of these estimates follows:

Fuel power plant. 99 replies. Maximum, 100 percent, occurring once. Minimum, 10 percent, occurring twice. Median estimate, 30 percent, occurring 12 times.

Water power plant. 46 replies. Maximum, 80 percent, occurring once. Minimum, 10 percent, occurring twice. Median estimate, 30 percent, occurring 7 times.

Transmission plant. 106 replies. Maximum, 75 percent, occurring twice. Minimum, 10 percent, occurring twice. Median estimate, 30 percent, occurring 16 times.

Distribution plant. 121 replies. Maximum, 75 percent occurring once. Minimum, 10 percent, occurring once. Median estimate, 30 percent, occurring 15 times.

Miscellaneous plant. 95 replies. Maximum, 100 percent, occurring twice. Minimum, 10 percent, occuring once. Median estimate, 30 percent, occurring 13 times.

Total plant. 79 replies. Maximum, 62 percent, occurring once. Minimum, 10 percent, occurring once. Median estimate, 33 percent, occurring twice.

The estimates presented here are based on data furnished by some 220 electric utilities which together represent 85 percent of the total industry in terms of generating capacity, and 80 percent of it in terms of customers served.

ANNUAL CAPITAL EXPENDITURES FOR NEW CONSTRUCTION
Electric Light and Power Industry

(In Thousands of Dollars)

Year	Fuel	Hydro	Transmission	Substations*	Distribution	General Plant	Total
1932	40,000	20,000	60,000	30,000	110,000	25,000	285,000
1933	10,400	4,000	16,100	14,900	72,200	11,700	129,300
1934	10,258	5,704	30,180	11,921	76,299	13,292	147,654
1935	16,172	6,337	35,349	14,766	103,104	17,127	192,855
1936	36,820	9,030	20,170	25,050	174,640	24,000	289,710
1937	113,060	10,540	40,740	49,290	203,250	38,600	455,480
1938	133,000	17,600	36,000	46,400	215,000	34,000	482,000
1939	101,500	17,900	45,500	31,750	210,500	22,850	430,000
1940	200,430	9,270	55,900	57,760	237,700	35,520	596,580
1941	219,741	27,186	62,476	79,218	232,840	32,687	654,148
1942†	191,671	22,847	85,633	.....	144,180	11,644	455,975
1943	137,059	35,505	42,923	32,740	84,683	6,066	306,286
1944	96,126	19,888	61,196	40,663	151,969	11,105	340,284
1945	106,166	12,713	68,935	46,670	204,492	16,623	408,929
1946	190,955	18,974	106,550	62,754	360,980	40,710	718,169
1947‡	449,601	49,367	212,657	173,584	525,050	70,624	1,307,299

* After 1941, substation expenditures, although separately stated, are included in figures for transmission and distribution.
† Expenditure study not made by "Electrical World" in 1942. Figures are those reported by Federal Power Commission for privately owned utilities only.
‡ Prospective.

CONSTRUCTION EXPENDITURES*
As reported to Electrical World

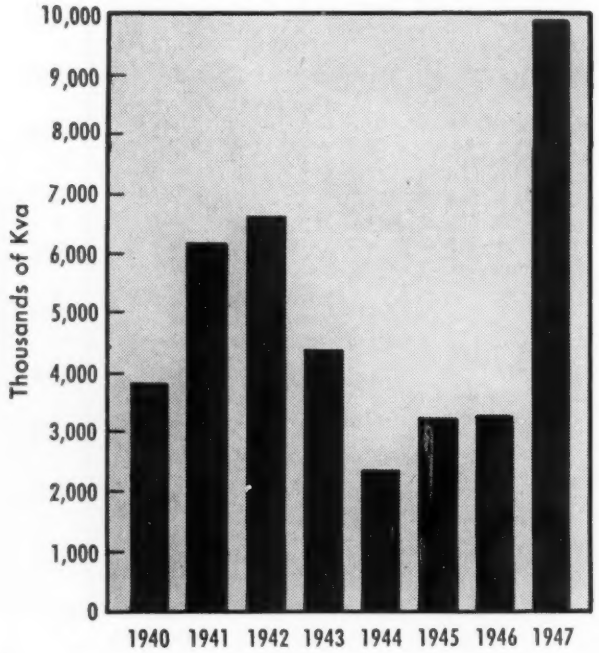
(Thousands of Dollars)

Regions	Fuel	Hydro	Transmission	Substations**	Distribution	General Plant	Total
Estimated—1946							
United States	190,955	18,974	106,550	62,754	360,980	40,710	718,169
New England	17,332	3,444	6,815	6,259	25,980	3,520	57,091
Middle Atlantic	49,120	510	19,600	7,960	56,030	7,890	133,150
E. North Central	39,190	50	18,510	14,520	87,410	11,010	156,170
W. North Central	25,970	420	8,710	3,330	24,620	5,910	65,630
South Atlantic	19,820	240	9,400	9,740	59,400	5,150	95,010
E. South Central	6,280	90	5,340	3,250	18,260	890	30,860
W. South Central	26,210	115	10,940	4,610	35,350	3,460	76,075
Mountain	1,403	4,165	3,335	1,785	10,550	1,010	20,463
Pacific	5,630	9,940	23,900	11,300	43,380	1,870	84,720
Prospective—1947							
United States	449,601	49,367	212,657	173,584	525,050	70,624	1,307,299
New England	31,906	15,662	11,517	11,904	37,470	6,164	102,719
Middle Atlantic	126,090	1,210	39,570	27,840	79,070	14,050	259,990
E. North Central	105,400	590	48,660	39,270	123,530	16,060	294,240
W. North Central	47,060	1,680	21,400	16,590	45,400	9,140	124,680
South Atlantic	46,030	750	18,470	18,600	85,320	8,590	159,160
E. South Central	12,830	310	7,360	8,410	24,340	2,060	46,900
W. South Central	29,110	40	26,580	15,800	48,420	5,150	109,300
Mountain	7,095	10,175	5,290	5,660	14,960	1,680	39,200
Pacific	44,080	18,950	33,810	29,510	66,540	7,730	171,110

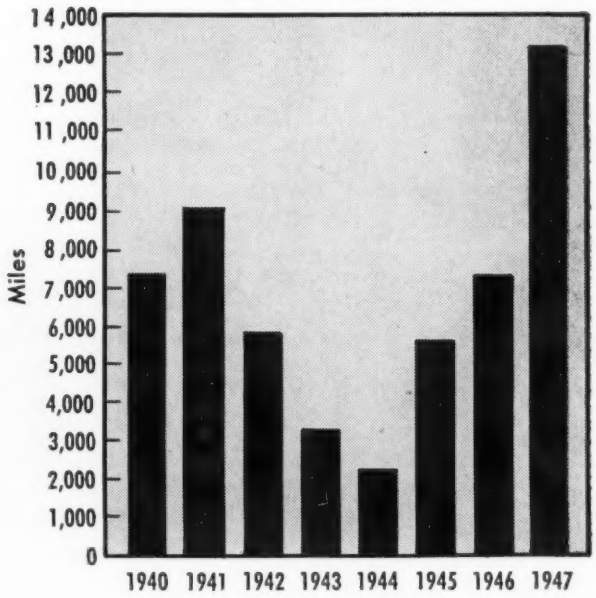
* Covers Power Companies, State Authorities and Municipal Plants. Excludes REA, TVA, Reclamation Bureau and Other Federal Projects.
** Substation expenditures, although separately stated, are included in figures for transmission and distribution.

Transmission and *Substations*

NEW SUBSTATION CAPACITY



NEW TRANSMISSION LINES



CONSTRUCTION of substations in 1946 lagged far behind what had been anticipated at the beginning of the year; capacity of 3,319,000 kva. was installed; 7,492,000 kva. had been planned. For 1947, installation of 9,966,000 kva. is contemplated, almost exactly three times as much as was installed in 1946. The plans for 1947 are about 50 percent larger than the substation installation of 1942, that year of high-pressure preparation for war production.

Transmission line mileage built in 1946 came closer to what had been planned than did substation capacity; 7,334 miles erected of 10,883 planned. Projected for 1947 are 13,242 miles. This figure, if attained, will be the largest of any year of record of such construction.

CONSTRUCTION OF SUBSTATIONS

(In Thousands of Kva.)

Region	1943	1944	1945	1946	1947*
New England	208	22	193	155	806
Middle Atlantic	460	221	199	320	1,610
East North Central	1,067	390	398	800	1,970
West North Central	443	72	207	160	780
South Atlantic	340	223	727	330	1,190
East South Central	868	377	518	260	450
West South Central	277	165	266	262	1,030
Mountain	139	18	215	32	310
Pacific	579	923	554	1,000	1,820
United States	4,381	2,411	3,277	3,319	9,966

Source: "Electrical World" Surveys. * Estimated.

CONSTRUCTION OF TRANSMISSION

(In Miles—11 Kv. and Up)

Region	1943	1944	1945	1946	1947*
New England	43	34	74	259	502
Middle Atlantic	232	149	290	510	1,040
East North Central	467	248	677	750	2,740
West North Central	308	178	1,628	1,060	2,300
South Atlantic	800	378	357	1,230	1,570
East South Central	206	355	335	360	280
West South Central	550	389	921	730	1,640
Mountain	321	70	406	1,320	1,520
Pacific	366	413	980	1,115	1,650
United States	3,293	2,214	5,668	7,334	13,242

Source: "Electrical World" Surveys. * Estimated.

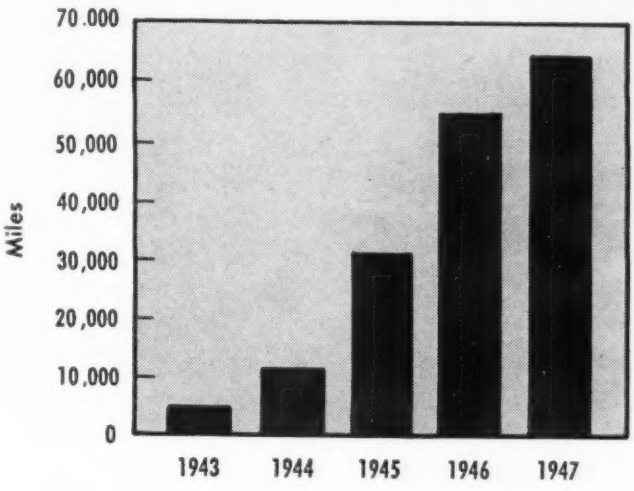
Rural Lines

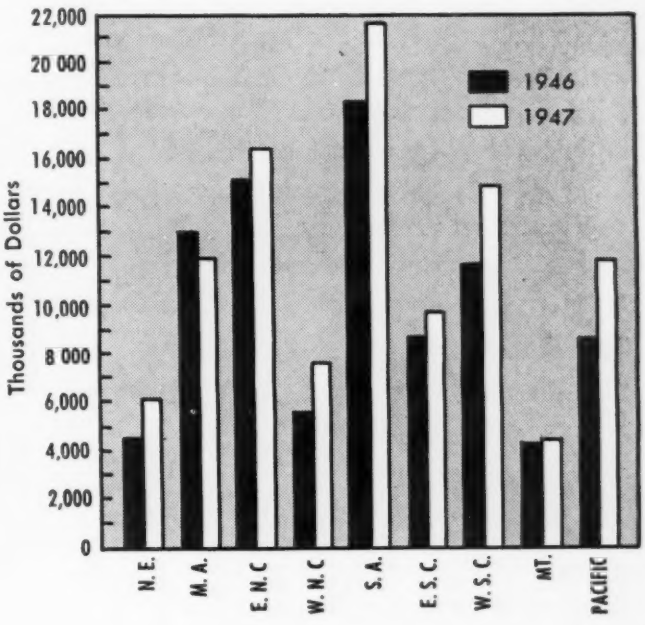
63,884 miles in 1947

QUITE DIFFERENT from other kinds of electric utility construction, practically all of the rural line mileage projected for 1946 was built during the year; the accomplishment came within 4 percent of being complete, 57,382 miles planned, 55,387 miles built.

When plans for 1946 were being made, costs of labor, materials and equipment were at a much lower level than a year later. The ratio of miles of line to estimated expenditure (this is not cost per mile) was 1 to 1,400 when plans were made for construction of rural lines in 1946. The ratio for lines actually built in 1946 works out 1 to 1,612, and in plans for 1947 it is 1 to 1,640.

Analysis of 90 reports to ELECTRICAL WORLD of estimates of increase in rural line construction costs since the war disclose a median value of 30 percent, which is also the value of most frequent occurrence, 16 times. The highest and lowest estimates of increase were 55 and 7 percent, each occurring once.





MILES OF RURAL LINE EXTENSIONS*

Regions	1943	1944	1945	1946	1947†
New England	72	196	957	2,242	4,758
Middle Atlantic	642	3,160	4,876	6,220	5,480
East North Central	1,073	2,065	5,475	9,290	8,970
West North Central	614	1,724	2,744	3,860	5,700
South Atlantic	321	473	4,563	12,200	13,390
East South Central	98	301	3,894	5,720	6,200
West South Central	490	1,992	4,376	8,335	10,910
Mountain	106	180	2,075	3,550	2,880
Pacific	546	842	1,440	3,970	5,590
United States	3,962	10,933	30,900	55,387	63,884

Source: "Electrical World" Surveys.
*REA not included. †Estimated.

RURAL LINE CONSTRUCTION EXPENDITURES*

(In Thousands of Dollars)

Regions	1945	1946	1947†
New England	1,084	4,426	6,068
Middle Atlantic	9,187	12,990	11,940
E. N. Central	6,550	15,160	16,340
W. N. Central	3,900	5,410	7,580
South Atlantic	6,600	18,200	21,770
E. S. Central	5,805	8,670	9,680
W. S. Central	6,087	11,670	14,830
Mountain	2,503	4,280	4,550
Pacific	4,212	8,490	11,880
United States	45,928	89,296	104,638

Source: "Electrical World" Surveys.
*REA not included. †Estimated.

Labor

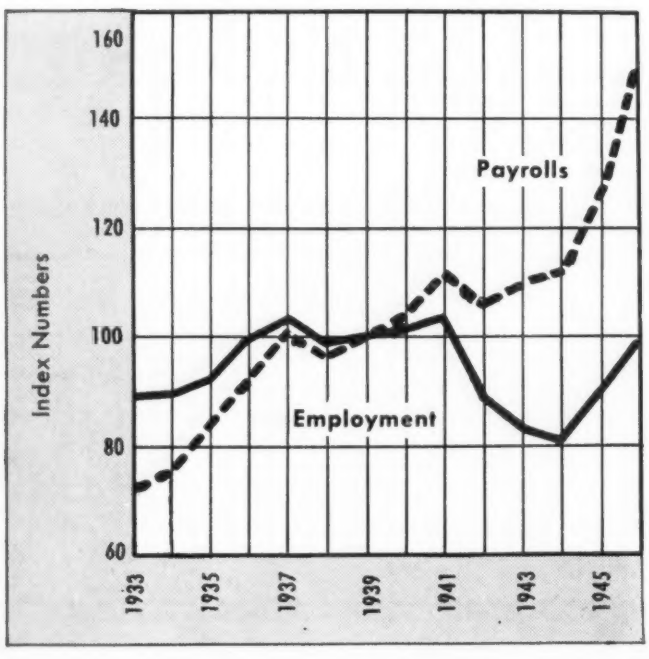
utility employment and wages

WAGES WERE INCREASED, hours reduced, and employment expanded in the electric light and power industry during 1946.

Average hourly earnings of workers in electric light and power companies advanced to about $1.27, a gain of about 8 cents an hour. This was sufficient to raise the weekly pay envelope to about $52.60 (the estimated average for the industry at the end of 1946), as compared with $50.49 a year earlier. Meanwhile, the length of the work week continued to decline from the war-time peak, with workers averaging around 41.5 hours a week on the job.

The growth of the worker's income in the electric light and power industry over the past 15 years is pictured in the accompanying chart. Since 1932, average hourly earnings have risen 90 percent. The gain in weekly earnings since 1932 has been somewhat less—about three-fourths—as the length of the work week was reduced from 44.1 hours to its present level of 41.5 hours.

TREND OF PAYROLL AND EMPLOYMENT IN ELECTRIC UTILITIES



A predominant part of this increased pay has come to labor since 1940. At that time average hourly earnings were $0.90. During the war years wage rates were advanced, and some upgrading of workers was done. Moreover (in contrast to the longer term trend) the work week was lengthened as labor became scarce. In 1940 wage-earners were on the job an average of only 39.1 hours, and they drew no overtime pay on this basis. Today many workers still draw some pay at overtime rates, although much less so than in 1944, when the average hours worked rose to more than 43 per week for the industry as a whole.

This combination of a longer work week with some overtime pay, and a rapid increase in hourly wage rates, has served to put about 50 percent more cash in the weekly pay envelope today than it held in 1940. Weekly earnings averaged $35.37 at the earlier date; now they total about $52.60.

The rapid advance in wage costs over recent years has occurred in the face of declining electricity rates. This is in sharp contrast to most other industries, where higher wages have been offset to a considerable extent by higher prices (particularly during 1946). However, the electric light and power industry has been able to double its output over recent years without increasing the total number of workers. Higher load factors, improved equipment, and a general increase in efficiency have all contributed to this great achievement. As a result, output per man-hour has advanced substantially since the years of the late nineteen thirties.

The course of employment in the electric light and power industry also serves to support this conclusion. Employment reached a peak in 1941, when (at the year end) approximately 256,000 wage-earners were at work in privately owned operating companies. During the war years operating companies found themselves squeezed by stringent manpower regulations. As they lost men to the services and to war plants, employment fell to 200,000 (at the end of 1944). Thus, while electric power output was leaping upward some 37 percent, employment was falling a fifth.

During the past year electric light and power companies have sought to restore their working staffs to a level that is consistent with a service of maximum efficiency. For the most part this has been accomplished by the return of veterans to their jobs —the high rate of such returns in itself has constituted a tribute to working conditions in the industry. Employment at the year end approximated 246,000, considerably above the 1944 low but still less than the 1941 high.

The extent to which payrolls have outstripped employment is shown charted on the opposite page. At the end of 1946, the employment index stood at about the 1939 level, but the index of payrolls towered 52 percent above 1939.

The rise of labor costs is of course not unique to the electric light and power industry. As a matter of fact, average hourly earnings of workers in manufacturing as a whole have advanced somewhat more rapidly since 1940 than has been the case in the electric light and power industry. Nevertheless, the worker in electric light and power still earns considerably more on the average than the worker in manufacturing, particularly on a weekly basis. The electric light and power worker receives some 12 percent more in his weekly pay envelope than does the average worker in manufacturing.

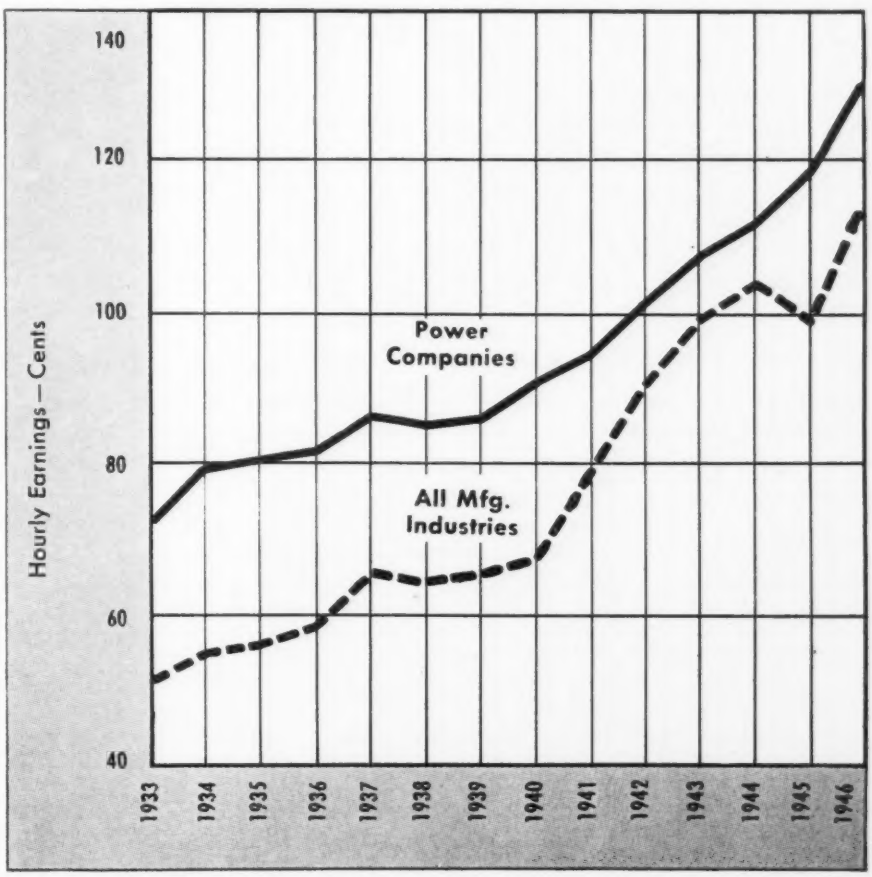
WAGES AND EMPLOYMENT IN ELECTRIC LIGHT AND POWER COMPANIES

(December of each year)

Dec.	Aver. Hrly Earnings (in cents)	Aver. Weekly Earnings (in dollars)	Est. No. of Employees (thousands)	Aver. Weekly Hours	Index of Employment Dec. 1939 =100	Index of Payrolls Dec. 1939 =100
1932	66.8	29.90	212	44.1	85.9	71.6
1933	72.2	29.06	219	39.9	88.5	72.2
1934	79.1	30.35	220	38.5	89.0	76.1
1935	80.5	32.10	229	40.0	92.6	84.1
1936	81.9	33.00	246	40.7	99.7	92.1
1937	87.3	34.94	255	40.1	103.1	101.2
1938	86.1	34.33	243	40.0	98.2	97.1
1939	87.1	34.64	247	39.7	100.0	100.0
1940	90.4	35.37	250	39.1	101.3	103.5
1941	94.0	37.73	256	40.3	103.4	112.5
1942	102.2	41.94	221	40.8	89.3	107.3
1943	107.8	46.48	205	42.9	83.1	109.7
1944	111.9	48.84	200	43.3	81.0	112.4
1945	118.6	50.49	222	42.0	89.6	127.3
1946*	126.8	52.59	246	41.5	99.8	151.5

* 1946 is an estimate by Electrical World on basis of October data from Bureau of Labor Statistics.
Source: Bureau of Labor Statistics.

HOURLY EARNINGS OF WORKERS



Manufacturing

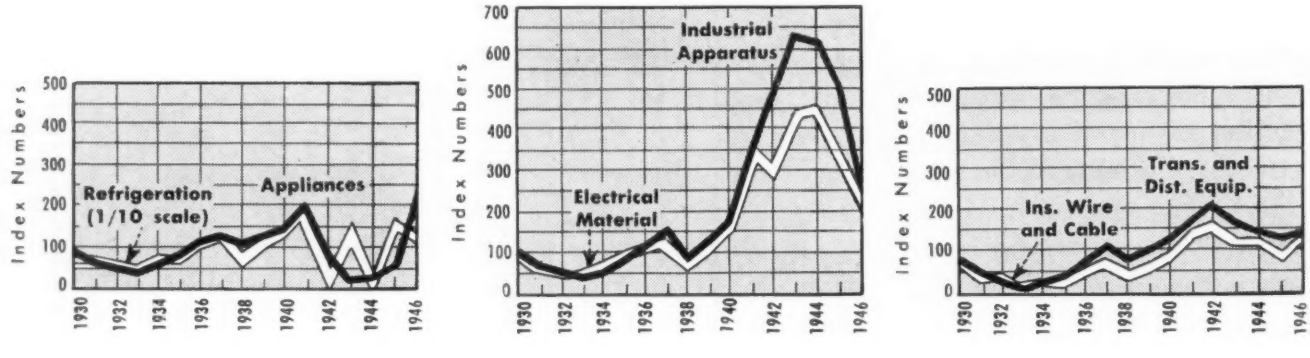
appliances lead in post-war production

DESPITE the unsettled industry conditions and the difficulties of obtaining materials for manufacture in 1946, production of electrical appliances reached an index figure much higher than any in the preceding ten years. The production index for refrigerators, while not the highest for the ten-year period, was actually next below it. This remarkable post-war production recovery of electrical consumer goods, accomplished against great odds, is a firm augury of what will come when electrical manufacturing can really get going.

The 1946 production indexes for electrical material, industrial apparatus, and insulated wire and cable, reflect rather clearly the discontinuance of war-time orders, each showing a decline. The small upward climb of the index for transmission and distribution equipment indicates that the slackening off of war-time production in this line has been more than taken up by

MANUFACTURERS' SALES

(Index Numbers: 1925 = 100)



MAJOR BRANCHES OF ELECTRICAL MANUFACTURING INDUSTRY

(Index Numbers 1925 = 100)

	Manufacturers' Sales	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946*
1. Appliances	100 = $140,000,000	121	136	109	128	151	212	73	12	16	62	246
2. Refrigeration	100 = 16,000,000	1,131	1,360	769	1,100	1,331	1,800	264	158	25	170	1,363
3. Electrical material	100 = 38,000,000	116	131	83	116	149	253	318	447	453	343	233
4. Industrial apparatus	100 = 132,000,000	118	161	97	127	177	317	465	638	633	455	265
5. Trans. and dist. equip.	100 = 167,000,000	83	124	90	104	124	189	213	167	141	138	144
6. Ins. wire and cable	100 = 110,000,000	69	98	60	71	87	157	155	135	121	100	115

Source: NEMA * Estimated.

1. APPLIANCES include domestic kitchen and table appliances, electric anges, electric water heaters, electric vacuum cleaners, electric washing machines, electric fans and food service equipment.

2. HOUSEHOLD REFRIGERATION includes complete units, parts and cabinets. Commercial refrigeration equipment and air-conditioning equipment are excluded.

3. ELECTRICAL MATERIAL includes carbon, electrical porcelain, laminated phenolic products, manufactured electrical mica and vulcanized fiber. Molded insulation is excluded.

4. INDUSTRIAL APPARATUS includes electric welding equipment and wire, industrial controls, industrial heating equipment and motors and generators (excluding all generators except motor-generator sets). Electric furnaces and electric tools are excluded.

5. TRANSMISSION AND DISTRIBUTION EQUIPMENT includes switchgear, high-voltage insulators, power and distribution transformers, lightning arresters, pole line hardware and earth anchors, panelboards and distribution boards, small air circuit breakers and watthour and demand meters.

6. INSULATED WIRE AND CABLE for light and power includes only the following types: weatherproof wire, paper-insulated power cable, varnished cambric cable, rubber-sheathed cord and cable and rubber-covered building wire.

All indices based upon U. S. Census of Manufacturers data and NEMA statistical department data corrected where possible to represent the entire industry.

THE INDUSTRY AND RELATED FACTORS

(Index Numbers 1925 = 100)

	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946 *
1. E. M. I. production.....	119	137	97	123	154	276	415	522	553	390	276
2. E. M. I. employment....	100	117	80	98	129	189	228	282	271	228	176
3. F. R. B. production.....	113	124	97	120	137	178	219	263	258	223	179
4. Sales of electricity.....	180	199	187	212	238	281	319	372	396	387	372
5. Population.....	112	113	113	114	115	116	117	119	120	122	122

Source: NEMA * Estimated.

1. E.M.I. PRODUCTION based on U. S. Census of Manufacturers and data compiled by NEMA statistical department. In addition to products shown in electrical machinery apparatus and supplies schedule of the Census there are included electric refrigeration, radio apparatus and supplies, steam turbines for electrical drive, electrical porcelain, glass insulators and electric washing machines. Indices for the war years reflect production of non-electrical as well as electrical goods.

2. E.M.I. EMPLOYMENT based on labor series of National Industrial Conference Board, but adjusted to 1925 = 100. This series represents the electrical manufacturing industry including radio and includes latest revision to Census figures made by N.I.C.B.

3. F.R.B. PRODUCTION based on the Federal Reserve Board's revised index for the manufacturing industry and adjusted to 1925 = 100. (Includes all revisions made by Federal Reserve Board up to December 15, 1943.)

4. ELECTRIC POWER SALES index figures based upon Edison Electric Institute data.

5. POPULATION based upon the annual mid-year estimates of the U. S. Bureau of the Census.

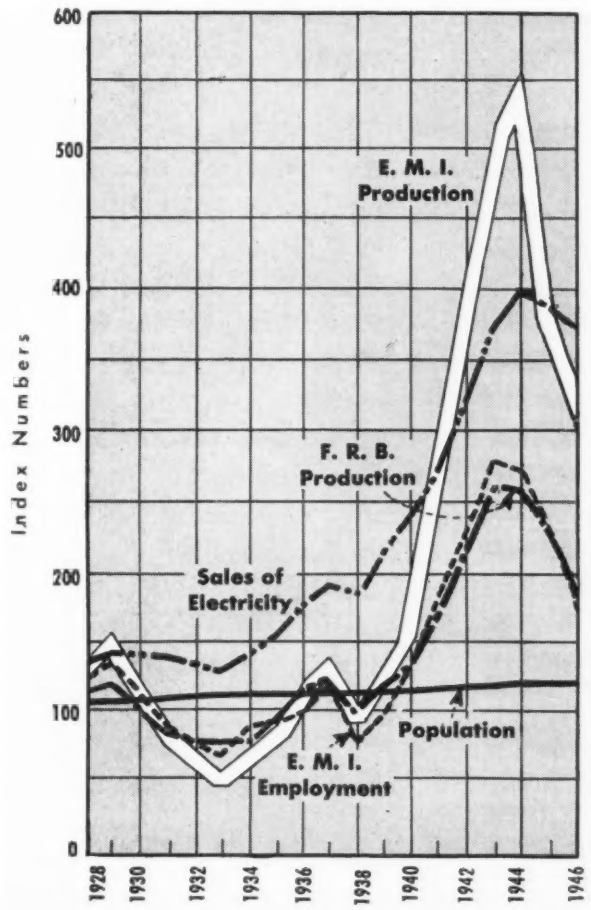
orders for goods for peace-time uses.

Trends in E.M.I. (Electrical Manufacturing Industries) production and employment continue downward from their respective high points in 1944 and 1943. The trend of the two indexes results directly from subsidence of war production, somewhat countered by increasing manufacture of peace-time goods. The divergence between the indexes of E.M.I. and F.R.B. production which began in 1940 and widened when this country entered the war, was maintained through 1946. The gap between these two indexes is already considerably narrowed from what it was during the war years and they can be expected to come closer. With the post-war demand for electrical goods remaining consistently strong, it is not likely, however, that the two indexes will return very soon to the condition of practical coincidence of the years before the war.

Indicative of the work ahead for electrical manufacturers is the estimate of 1947 construction expenditures of utilities totalling $1,300,000,000. Not all of this sum represents business for electrical manufacturers, but their share of it is large. Then there is the market for electrical goods in the job of providing modern housing for a large segment of the population, plus the requirement of materials, equipment and apparatus for new commercial and industrial establishments and for modernization of existing ones. Considering these factors it seems that the E.M.I. production index will remain above the general average of the nation for some considerable time to come.

The graph to the left, of electrical manufacturing in comparison with certain basic national factors, shows by the change in slope of the E.M.I. production curve that in 1946 the decline from the war peak was checked in some degree, even though the industry was beset by troubles.

ELECTRICAL MANUFACTURING IN COMPARISON



REA

getting to a farm service basis

SIGNIFICANT RATIOS of operations of REA cooperatives for 1946, derived from total statistics presented on this page, reflect a truer picture of rural electric service than do the ratios of previous years. The figures for 1944 and 1945 are considerably distorted by the inclusion in them of the operations of the Ark-La Electric Cooperative in furnishing large amounts of energy for aluminum production. This factor is absent from the 1946 figures.

Ark-La operated through all of 1944, for nine months of 1945, and not at all in 1946. This change is clearly apparent in the following ratios for the three years:

Cost of input energy rose from 8.47 to 8.52 to 8.65 mills per kw.-hr.

Revenue from energy sold rose from 3.31 to 3.43 to 3.68 cents per kw.-hr.

Average consumer annual bill rose from $55.50 to $55.60 to $57.70.;

While average annual energy usage per consumer declined from 1,668 to 1,621 to 1,578 kw.-hr.;

And operating ratio rose from 57.2 to 57.4 to 59.6 percent.

Average cost of REA distribution lines is of the order of $1,137 per mile. This figure results from the division of 1946 funds allocated for distribution lines, shown in the table, by 762,000, which is the allocations estimate of miles of line.

The allocations estimate of consumers, as of December 31, 1946, is 2,341,000; dividing this figure into total funds allocated gives $408 allocated per consumer for all purposes, including consumer facilities.

Item	Calendar Year 1944	Calendar Year 1945	Calendar Year 1946 [1]
Cumulative Year-End Data			
Total Funds Allocated	$517,699,947	$666,954,331	$957,000,000
Distribution Lines	$456,335,090	$593,229,377	$852,400,000
Generation and Transmission	$49,662,394	$61,430,591	$91,400,000
Consumer Facilities	$11,702,463	$12,294,363	$13,200,000
Funds Advanced	$406,370,722	$463,541,933	$595,000,000
Systems in Operation	826	848	872
Miles of Line in Operation	410,471	449,493	500,000
Consumers Connected	1,216,798	1,409,494	1,675,000
Systems Generating Power	65	76	79
Generating Plants—Kw. Capacity	76,500	92,544	112,847
Annual Data			
Energy Generated—Kw.-Hr	213,461,544	258,409,217	322,000,000
Energy Purchased—Kw.-Hr	2,105,332,282	2,343,186,761	2,648,000,000
Total System Input—Kw.-Hr	2,318,793,826	2,601,595,978	2,970,000,000
Energy Sold—Kw.-Hr	1,925,734,206	2,135,850,588	2,424,000,000
Operating Revenues	$64,042,574	$73,203,146	$89,050,000
Cost of Power [2]	$19,622,451	$22,183,149	$25,680,000
Distribution Expenses—Operations	[3] $17,018,382	$4,607,424	$6,660,000
Distribution Expenses—Maintenance		$3,026,944	$4,150,000
Consumers Accounting & Collecting		$2,550,945	$3,320,000
All Other Operating Expenses		$9,681,552	$13,230,000
Total Operating Expenses	$36,640,833	$42,050,014	$53,040,000
Net Non-Operating Margin	$560,492	$623,251	$780,000
Interest Expense	$8,750,278	$7,509,371	$8,270,000
Net Revenue Before Depreciation	$18,996,377	[4] $24,244,549	$28,520,000
Depreciation	[5]	$12,732,766	$14,540,000
Net Margin After Depreciation	[5]	$11,511,783	$13,980,000
Payments to Government Cumulative Data			
Interest Due	$40,930,604	$49,442,566	$59,300,000
Interest Paid	$40,634,176	$48,896,243	$58,500,000
Principal Due	$27,365,109	$36,054,846	$47,700,000
Principal Paid	$45,331,068	$55,812,174	$67,300,000
Overdue Amounts—More than 30 days	$373,959	$632,946	$865,000
a. Interest	$271,149	$464,378	$540,000
b. Principal	$102,810	$168,568	$325,000
Advance Payments of Principal	$18,085,514	$19,975,527	$20,000,000

Source of Data: Monthly operating reports of REA Borrowers.

[1] Based on ten (10) months actual data and one (1) to three (3) months estimated. Figures on borrowers' operations based on all reports received from borrowers; other data based on records of the Rural Electrification Administration.

[2] Cost of Power includes cost of purchased power and prime costs involved in the production and transmission of generated energy.

[3] Expense breakdown shown for 1945 and 1946 not available for 1944 because of revision in the reporting practice of REA borrowers. Consolidated expense reflects the sum of bracketed items. The change in presentation does not affect the comparability of total expense or net revenue for the three years shown.

[4] After deducting miscellaneous revenue deductions of $22,463 not shown separately.

[5] Data not summarized.

HOW

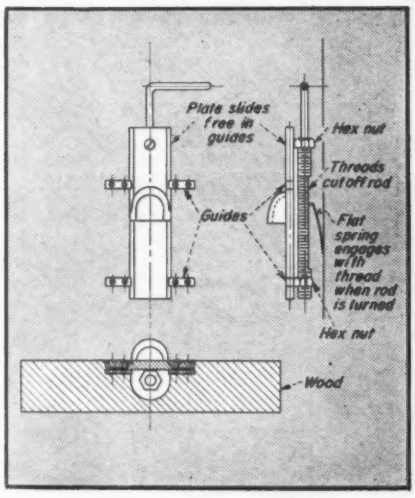
DESIGN • CONSTRUCT • OPERATE • MAINTAIN

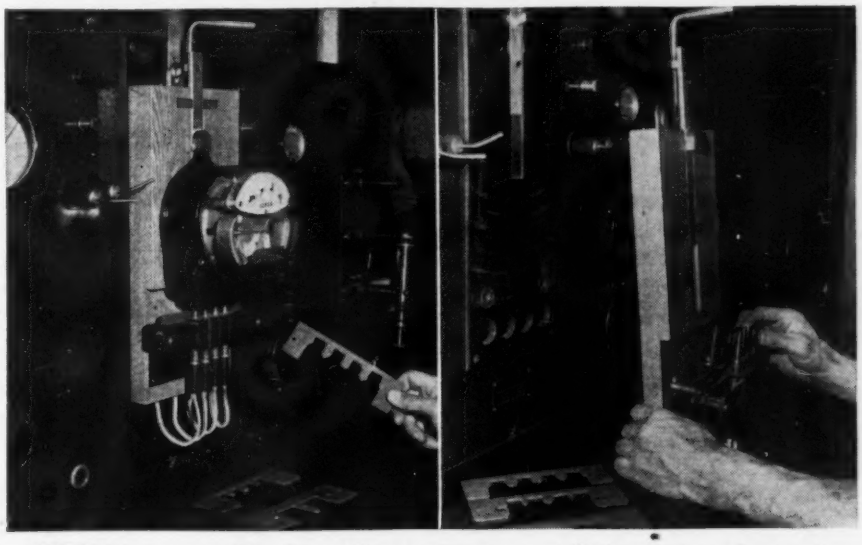
Adapter Test Board Accommodates All Type "A" Meters

H. D. NOREN, Coast Counties Gas & Electric Co., Santa Cruz, Calif.

AUTOMATIC SPACING of test studs to fit any type of meter and a positive pressure lock for supporting the meter are features of the test board illustrated, used by Coast Counties Gas & Electric Co. Spacing of leads is accomplished by the use of the notched fiberboards shown, which automatically space properly the contact pins on a States Quick Contactor terminal block. Four such spacers will accommodate all type "A" meters. On the back side of the block are long friction contact rods that permit the block to be moved in or out to line up exactly with terminals of the meter to be tested.

PRINCIPLE of pressure lock for clamping meters on test board





METERS are quickly clamped in place for test (left view) with simple locking device. Fiberboard guides (right) automatically space test block studs for any "A" type meter. Another adapter panel is used for "S" meters

Principle of the quick setting positive clamping lock that engages the hanging lug of the meter is shown by the accompanying drawing. After the proper fiberboard spacing strip has been inserted, the meter is rested on the tapered stud leads and is then forced down for good contact and clamped securely by a quarter turn of the locking rod on back of clamp.

The wooden board illustrated which incorporates these features is itself an adapter test board with contact blades on the back that engage recessed clips built into the test panel. Another adapter panel is provided for type "S" meters. Thus, changing from type "A" to type "S" meters, or from one to another of the several types and makes of "A" meters, is only a matter of seconds.

An ELECTRICAL WORLD *Comparison of Practice . . .*

Keeping Rural Right-of-Way Acquisition Costs Down

HOW MUCH of the usual right-of-way procedure is justified for the building of rural distribution? Line costs in the range of $1,000 to $1,500 per mile can be affected heavily in percentage if expense of abstracts, surveys and negotiation for easements is added. Costs considered moderate for major transmission lines loom large for the few hundred-kilowatt rural feeder.

There are highly legalistic questions involved in rights-of-way and no set of answers would cover all the situations or even the general conditions in all states. A survey of practices is not the place to discuss the legal angles, but the experience—if not the theory—can be reviewed to advantage. About all of the combinations possible are represented in the accompanying summary of practices followed by 16 companies.

One company, using only a permit form, makes this comment: "We real-

ize that in operating under this policy we are subject to eviction. However, our experience has been that the number of times that we have been required to move lines has not been frequent enough to affect our policy." Another, using a recordable easement but not securing abstracts or making surveys, comments: "There are probably a number of places in our set-up which leave us vulnerable, but our experience has been good enough to justify its continuance."

A company which makes a practice of setting all poles off the highway uses a simple form of permit which is not recordable. In another case, rights-of-way on private property are described "with the center line to be evidenced by the pole line when erected" in lieu of accurate surveys. Three companies have found it desirable to make surveys to establish highway limits for part or all of their lines, before building either on the road or private property side of the highway line.

Comparison of Rural Line Right-of-Way Practices

Company	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Build on highway	x	x	x	x	x	x	x	(1)	(1)					x	x	x
on private property adjacent road								(2)	(2)	x						
on private property far back											x	x	x			
Survey for highway limits		x						x		x						
Abstract of title										x						
Easement obtained and recorded		x		x	x			x		x		x				
Easement form used, not recorded			x			x			x				x		x	
Permit form signed	x										x					
Service contract includes permit							x	x						x		x

Notes: 1. Past or partial practice. 2. Present or preferred practices.

Provision for an easement may be included in the electric service contract signed by the customer. In one such arrangement, the customer, if not the owner, agrees to obtain an easement for the company and all instruments are recorded. Several companies have followed the practice of having trees trimmed and right-of-way cleared by the new customers.

An important exception is made by several companies not obtaining easements for regular construction along the road. When it is necessary to cross one property to serve another, they obtain signed easements which are recorded. Even then, however, it is not felt that surveys are needed.

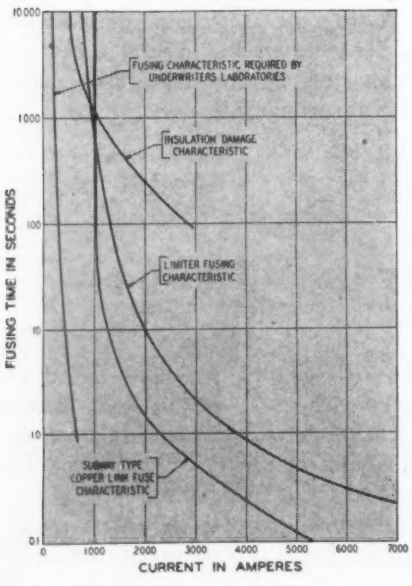
• • •

Limiter Development and Characteristics

JULIAN ROGOFF, Assistant Chief Engineer, Burndy Engineering Co., Inc., New York, N. Y.

THE 600-VOLT LIMITER is a fusible device especially designed to protect electrical distribution systems against the effects of electrical faults. Unlike an ordinary fuse, it is not intended to provide overload protection but is designed for short circuit protection only.

FIG. 1—Time-current characteristics for No. 4/0 cable limiter and fuses


FUSING CHARACTERISTIC REQUIRED BY UNDERWRITERS LABORATORIES
INSULATION DAMAGE CHARACTERISTIC
LIMITER FUSING CHARACTERISTIC
SUBWAY TYPE COPPER LAW FUSE CHARACTERISTIC
FUSING TIME IN SECONDS
CURRENT IN AMPERES

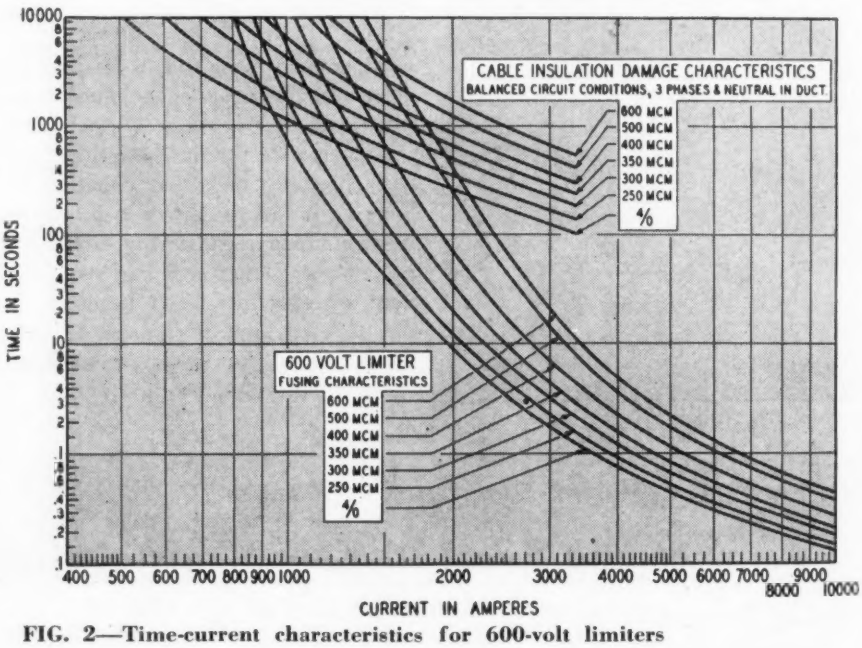


FIG. 2—Time-current characteristics for 600-volt limiters

Limiters are rated by *voltage* and *cable size*—not in amperes. The time-current characteristic curves of the limiters have been coordinated with the time-current cable damage characteristic curves. Rubber compound cable insulations, when heated to approximately 265 deg. C. for relatively short periods, are damaged perma-

nently and are unfit for further use. When the currents required to heat the cable to this temperature are plotted against time, the resulting curve is considered the cable damage characteristic curve. Such a curve is shown in Fig. 1. Ideally, the time-current characteristic curve of the limiter should be parallel to and just below the cable damage characteristic curve. The curve for the limiter is much flatter than that of the ordinary copper link fuse, or that of an Underwriters' Laboratories listed fuse, and thereby permits the cable to carry overload currents without any sacrifice in protective ability.

Limiters should be installed in those portions of the electrical circuit where the system may be disturbed by short circuits even though it can safely carry temporary overloads, or as back-up protection for circuit breakers or other electrical apparatus which might fail to operate invariably under short-circuit conditions.

Time-current characteristic curves for limiters, for cable sizes from No. 4/0 to 600,000 cir. mil, are shown in Fig. 2. Time intervals plotted are total time to clear, including melting time plus arcing time.

The rated interrupting capacity of the limiter, at 600 volts, is 50,000 amp. rms. This means that the limiter can interrupt, at 600 volts, without external disturbance, at least 50,000 amp. rms. at the start of arcing of the fusible section. To determine the maximum fault current the limiter can interrupt for any specific application of the device, allowance must be made for the transient d.c. component.

At normal operating currents, that is, at the normal current carrying capacity of the cable to which it is attached, the limiter has low temperature rise. The housing of the limiter, as well as the terminals on its ends, operates at a temperature rise of approximately 30 deg. C. above ambient temperature.

The 600-volt limiter has a tubular copper housing which prevents damage to the internal construction in the event of rough handling during transportation or installation.

• • •

Analyzing Substation Structural Weights

THE ENGINEERING DEPARTMENT of an eastern power system group, in seeking ways to shorten preliminary estimates of substation construction costs, has developed a tabulation of steel structural quantities and economic data which shows at a glance the basic information applying to this class of work. Some 65 installations have been tabulated to date, and from these it is possible to obtain a quick idea of the amount of steel needed for a substation of given number of bays of stated dimensions and cubical volume. Costs of steel for each job, weights per cubic foot of structural size, price data, ordering dates in years and months, print numbers and special notes are included.

Partial Tabulation of Data Used in Estimating Substation Steel Needs

Station	Total Wgt. Lb.	No. Bays	Wgt. Per Bay (Lb.)	Width Ft.	Length Ft.	Height Ft.	Vol. Cu. Ft.	Wgt. (Lb./Cu. Ft.)
Sta. A 110 Kv	46,000	1	46,000	48	58	62	125,000	0.378
110 Kv. Tower	9,000	1		10	10	62		
Cross Bus Truss AB	4,200	1		4	44	4½		95½ lb./1 in. ft.
Line Truss AC.....	5,300	1		4	54	4½		98
OCB Truss AD	5,000	1		4	54	4½		92½
Line Sect. Sq. Twr.	6,800	1				34		
Sta. B 110 Kv.	84,960	2	42,500	48	96	45	208,000	0.408
Car. Cur. Stand	350							
Cap. Stand	900							
Sta. C 110 Kv.	53,500	1	53,500	48	58	54	125,500	0.426
110-Kv. Sw. Sta.	93,000	3 Cir. Pos.	31,000	94	114	42	450,000	0.206
Tower	4,700	1		4	4	42		
Truss P	1,850	1			34			53½ lb./ft.
Q	2,350				34			68½ lb./ft.
R	2,400	1		2½	47	4		53 lb./ft.
S	1,700	1			34			50 lb./ft.
T	4,460	1			34			61½ lb./ft.
110-Kv. LA Stand	2,650	1						
Sta. D. 110 Kv.	155,000	5 Cir. Pos.	31,000	94	190	42	750,000	0.206
Sta. E. 110 Kv. Est.	98,000	3 Cir. Pos.	32,750	94	114	42	450,000	0.218

• • •

Some Properties of Polydichlorostyrene

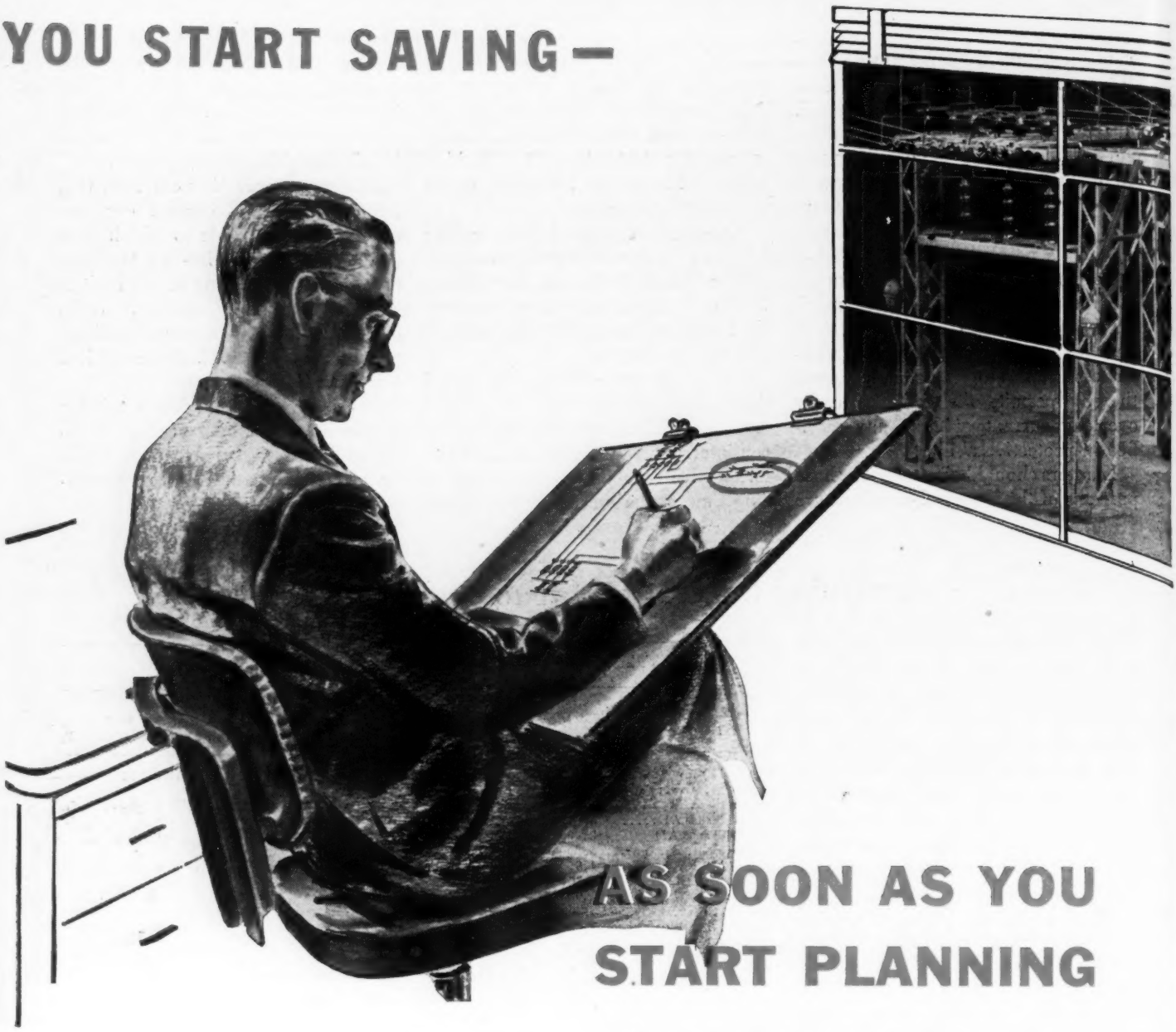
ELECTRICAL PROPERTIES, heat resistance, and moldability of the plastic, polydichlorostyrene, were outlined recently before the Chicago Section of the Society of Plastics Engineers by Laurence E. Russel of The Mathieson Alkali Works.

Polydichlorostyrene can be maintained at 220 deg. F. without dimensional changes or appreciable loss in strength, and, in addition, it retains a power factor ranging from about 0.0003 to 0.0008 between 100 and 1,000,000 cycles. Its dielectric constant in this range varies from 2.64 to 2.66. Furthermore, it absorbs less water than any other thermoplastic—0.02 percent on the average—and its strength properties compare very favorably with all the commonly used thermoplastics. On the Rockwell M scale it exhibits a hardness rated at 95 which is not very much decreased at elevated temperatures, and its resistance to acids and alkalis at elevated temperatures is excellent.

The Mathieson plastic is said to exhibit excellent dimensional stability and resistance to cold flow. It flows readily into intricate shapes and is inert to metal inserts. Mold shrinkage averages only 2 mils per inch. Objects molded of polydichlorostyrene may be readily tapped and hold screws firmly in threaded holes.

Some applications now practical for the plastic are: battery caps and cases, gaskets, tube bases, terminal blocks, instrument handles, chemical- and hot water-resistant parts, pump parts, generator parts, and miscellaneous hardware. Also it may be used for other products for which resistance to high temperatures and low water absorption are desired.

YOU START SAVING—

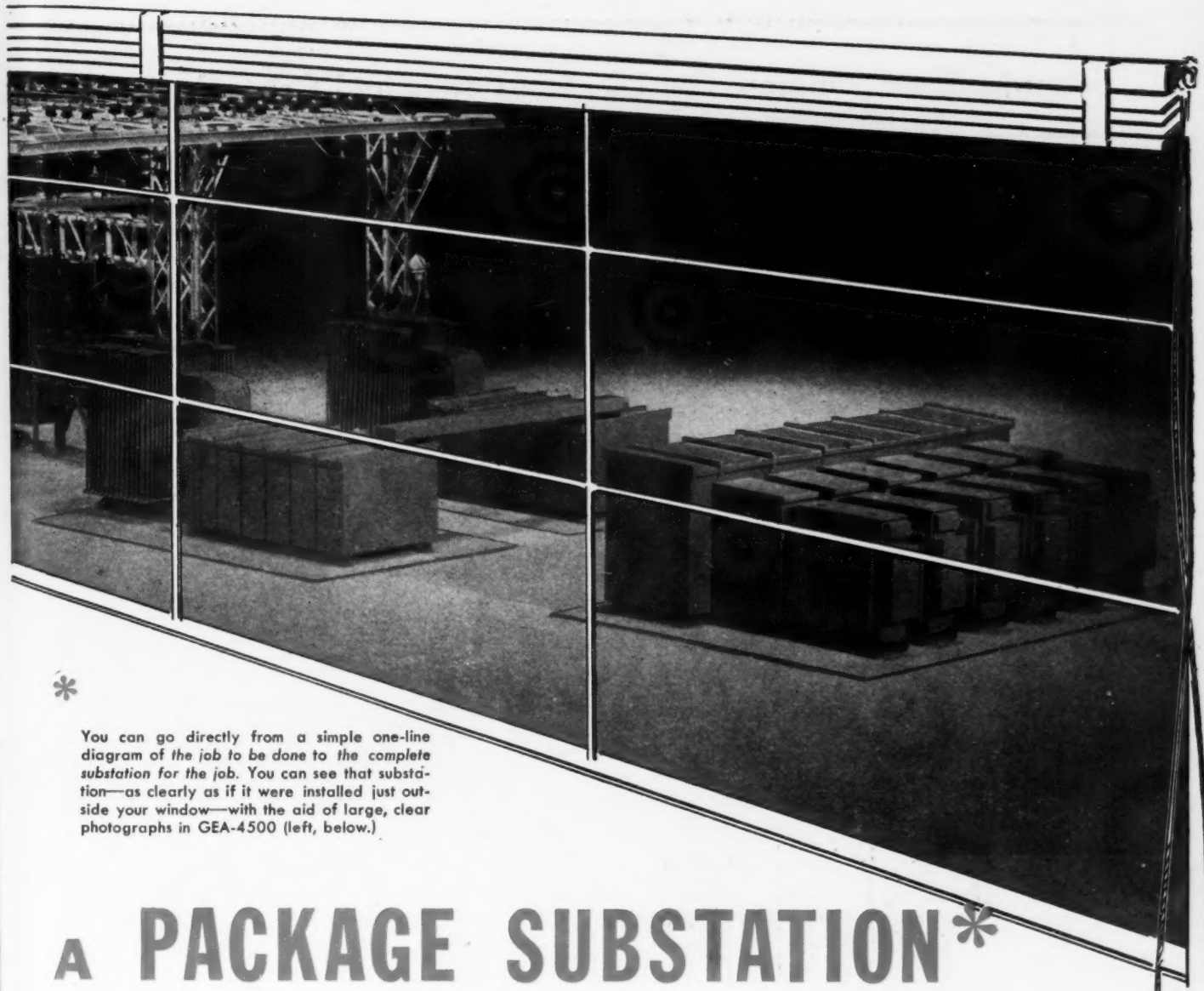


AS SOON AS YOU START PLANNING

Regardless of the size and type of substation you need, you can now cut out costly months of detailed planning by going directly from *the job to be done* to *the complete substation for the job.*

This is made possible by General Electric's new *package substation*, which gives you—as a unit—a complete, co-ordinated package including one or more master unit substations, steel structure and *all* other electric equipment to match your exact needs. It extends the vital "buy it complete" trend throughout ratings from 750 to 45,000 kva; 11 to 69 kv, incoming, and 2.4 to 13.2 kv, outgoing.

You have hundreds of package substation combinations from which to select. The one to match your next specific application is likely shown in GEA-4500 (left). This helpful, 78-page bulletin describes 30 standard classes of package substations, gives you helpful application information on each,



You can go directly from a simple one-line diagram of *the job to be done* to *the complete substation for the job.* You can see that substation—as clearly as if it were installed just outside your window—with the aid of large, clear photographs in GEA-4500 (left, below.)

A PACKAGE SUBSTATION*

and shows you just how each will look installed. From these—and the hundreds of standard modifications—it's easy to select a package substation having the exact ratings, functions, circuits and physical arrangement for your job.

Whether your substation is to be small or large, simple or complex, you need prepare but *one specification*, place but *one order.*

Your General Electric sales representative can provide a copy of GEA-4500, and will gladly work with you on any substation application you have in mind. *Apparatus Dept., General Electric Company, Schenectady, N. Y.*

. . . and your savings continue for years

Installation is easy and economical Your package substation arrives in factory-assembled sections as large as shipping and handling facilities permit. It includes everything you need—right down to complete erection instructions. You can put the complete substation on the job quickly, easily, and economically.

You get a valuable flexibility for future needs Centralized design of G-E package substations permits exceptional flexibility to meet changing load requirements. Capacity can be added—or removed—in easily handled "blocks of power," to take care of increased load requirements, load shifts or relocations. You avoid costly modification of installed equipment, achieve a more economical use of your installed capacity.

Full co-ordination of all parts gives you a better, more dependable substation The package substation you order passes from the drawing board through the factory as a **unit**, receiving centralized supervision of the over-all design and assembly. The result is full co-ordination—mechanically, electrically, and thermally—that pays off in years of increased dependability and reduced maintenance.

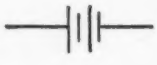
GENERAL ELECTRIC

821-53-5900

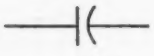
Standardized Symbols For Electric Power and Control . . . I

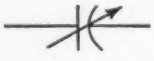
BATTERY

General . . . . . (The long vertical line is positive)



CAPACITOR

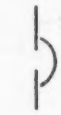
Fixed . . . . . 

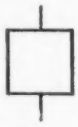
Continuously Adjustable . . . . . 

(Curved element for differentiation from symbol of contact and possibly battery)

CIRCUIT BREAKERS

(One Line Symbols)

Air . . . . . 

Oil (or other liquid) 

COILS

Operating Coil . . . .

or . . . . .

or . . . . .

*This symbol must always be used with an identifying legend within or adjacent to the circle

Blowout Coil with Leads . . . .

CONNECTIONS

Mechanical . . . . .

Direct Connected Units . . . . .

CONTACTS

Normally Closed (NC) . . . . .

or . . . . .

Normally Open (NO) . . . . .

or . . . . .

CONTACTORS

Fundamental symbols for contacts, coils, mechanical connections, etc., are the basis of contactor symbols

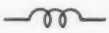
FIELD

Motors, Generators or . . . . .

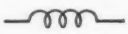
(Commutating, and/or compensating series and shunt fields indicated, respectively, by two scallops . . . .

or one loop . . . . .

three scallops . . . .

or two loops . . . . 

four scallops . . . . .

or three loops . . . 

FUSE

General . . . . .

Current Responsive Element . . . . .

INDICATING LIGHTS

General . . . . .

(Letter inserted to indicate color but in case of conflict with any other symbol, spell out)

INDUCTOR

(See WINDING)

INSTRUMENTS and METERS

General . . . . .

(Letter or letters inserted to indicate type of instrument)

LIGHTNING ARRESTERS

(One Line Symbols)

General . . . . .

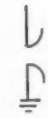
Auxiliary Series Sphere-Gap Type . . . . .

GRAPHICAL SYMBOLS have been standardized to depict electric equipment on drawings. Frequent items are designated by the accompanying list of symbols and two other lists scheduled to appear in ensuing issues. Basic symbols (ELECTRICAL WORLD, May 27, 1944, page 102), many general symbols and adaptations are included. For the complete approved list refer to publication Z32.3-1946 of American Standards Association.

Electrolytic or Aluminum Cell Type . . . . .

Valve or Film Type . . . . .

Multigap Type . . . .

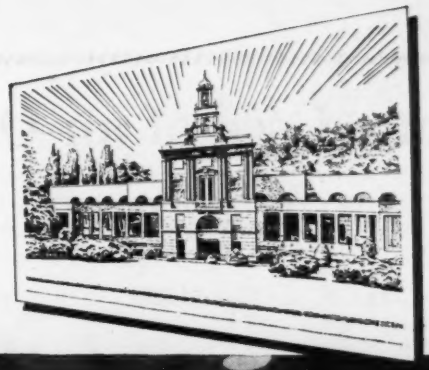
Horngap . . . . . 

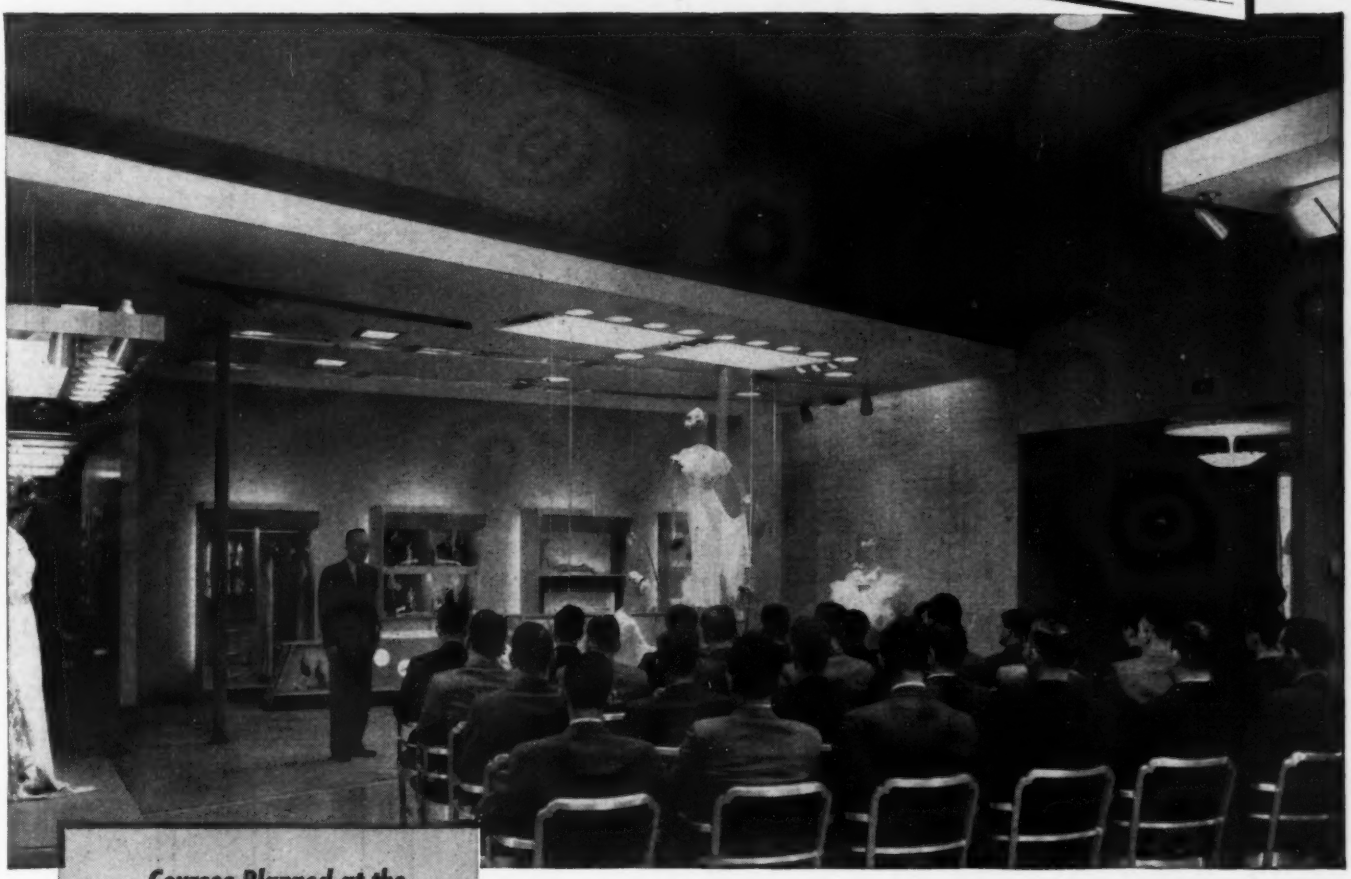
Auxiliary Series Horngap . . . . .

Protective Gap . . . .

Have you registered at the "University of Light"?

THE NEW GENERAL ELECTRIC LIGHTING INSTITUTE OFFERS A UNIQUE TRAINING OPPORTUNITY





Courses Planned at the General Electric Lighting Institute in 1947 include:

- Twelve 5-day courses in Fundamentals of Commercial and Industrial Lighting and four 3-day courses in Home Lighting Fundamentals, giving the basic groundwork for those new at the art.
- Six 5-day refresher courses in Advanced Commercial & Industrial Lighting and two 3-day advanced courses in Home Lighting, to bring experienced lighting men up to date.
- Two special conferences for Utility Lighting Directors, at which street lighting will be an important topic.
- Short courses and conferences for groups having special interest in a particular field of lighting—school executives, architects, office building managers, factory managers, merchandising executives.

Contact your G-E Lamp District Office for schedules and detailed information.

• Rapid advancement of lighting in 1947 will depend largely upon widespread knowledge of modern techniques. That's why General Electric has placed top priority on the important educational job that is being done week after week at the new General Electric Lighting Institute. Here at the "University of Light" is the training center of the industry, manned by a faculty drawn from the host of General Electric specialists in all fields of lighting.

We invite utility companies to make arrangements now with any G-E Lamp District Office to send their key men to Nela Park for fresh inspiration and up-to-the-minute instruction on "What's new in lighting". These courses are most popular, so register soon. General Electric Co., Lamp Dept., Nela Park, Cleveland 12, O.

G-E LAMPS

GENERAL ELECTRIC

Four Uses of an Ohmmeter in Meter Testing

JOHN BOWLES, Electrical Meter Dept., Illinois Power Co., Granite City, Ill.

1—CHECK CONTACTS

On a contact demand meter, the "hot" lead and the leads to the demand indicator or recorder are disconnected and the ohmmeter leads connected to the contact terminals of the meter. If a 3-wire contact is to be tested, a check is made from the common terminal to each of the other terminals separately. See Fig. 1. The demand meter is operated at full speed and the ohmmeter observed. If the pointer goes up the scale consistently and shows the same resistance on each contact, it is a good indication that the contacts are working satisfactorily. When the resistance readings are irregular and weak, the contacts need cleaning and adjusting. The same check should also be made with the demand meter operating at 10 percent load.

2—TEST RESISTANCE TO GROUND

The condition of the meter coil insulation or the terminal insulation may be determined by measuring the resistance from each terminal to the meter case (Fig. 2) or metal meter inclosure, if the meter case is grounded to the cabinet. Of course, the test switch must be open. Any resistance other than infinity should not be tolerated. This test is almost the equivalent of a breakdown test.

3—TEST POTENTIAL COILS

When a meter is not registering, an ohmmeter test is made for an open potential coil or coils as in the case of a polyphase meter. See Fig. 2. If the meter is not connected through a test switch the wires are dropped out before making the test. Where there is a test switch, it is only necessary to open the switch and measure the resistance of the potential coil. A reading on the ohmmeter indicates a good coil and no reading means an open potential coil.

4—CHECK C. T. SECONDARY

High resistance connections or open circuits in the secondary of a current transformer can be determined by aid of an ohmmeter. See Fig. 3. A note of caution is in order. Before making this test all primary load should be removed from the transformer, to avoid high voltage when opening the secondary. To make the test the secondary should be opened at the test switch and a piece of fiber inserted between the short-circuiting contacts. The resistance of each phase to the neutral or the common wire is measured. When the resistance of one phase is appreciably higher than the others, the connections should be carefully checked—preferably cleaned, tightened and another test made. It is possible for a meter to lose much of its registration because of a high resistance connection. This condition could go on for a long time without being found, unless this or a similar test is made.

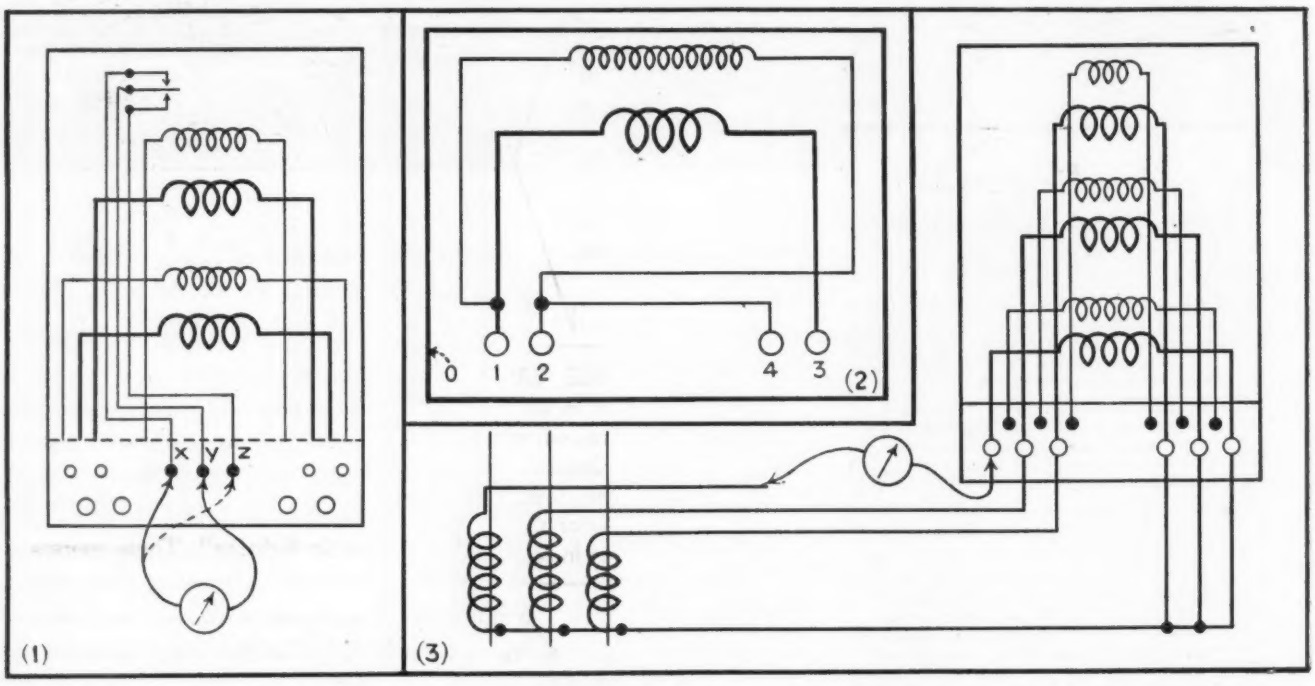
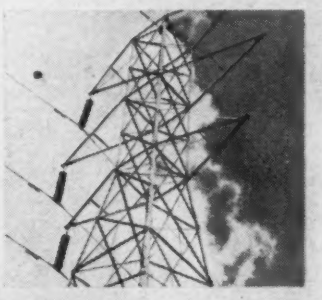


FIG. 1—Test for working condition of contacts; leads to demand indicator or recorder are disconnected . . . FIG. 2—(A) Test insulation of coils and terminals by connecting one ohmmeter lead to meter case at 0 and other lead, in turn, to terminals 1, 2, 3 and 4. (B) Test for open potential coil by connecting ohmmeter leads to terminals 1 and 4 . . . FIG. 3—Test for high resistance connection and open circuit in secondary of current transformer

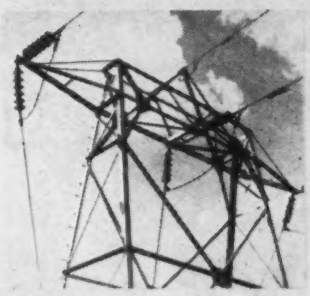
OF THIS INSULATORS



This line has operated with a fine record at 69 Kv. for nearly 25 years. Early in 1947 it will be raised to 132 Kv. without alteration--as originally planned--and with no question about insulation.

This line was built in 1927 with O-B pintype insulators which had already seen 11 years of previous service elsewhere on the system. The O-B insulators are still free from all trouble.

--AND HERE ARE SOME OF THAT SYSTEM'S REASONS LEADING TO THIS CHOICE



These 25-year-old O-B strain clamps have withstood the attacks of climate and corrosive atmosphere. This, plus desirable design, accounts for the continued use of O-B hardware.

In 1916, this line was built with 55-Kv., O-B pintypes and energized at 44 Kv. In 1921, it was raised to 69 Kv. For almost 25 years, these O-B insulators have operated at 25% over-rating.

Ohio Brass

2743-H

MANSFIELD, OHIO

Canadian Ohio Brass Company, Limited
Niagara Falls - - Ontario

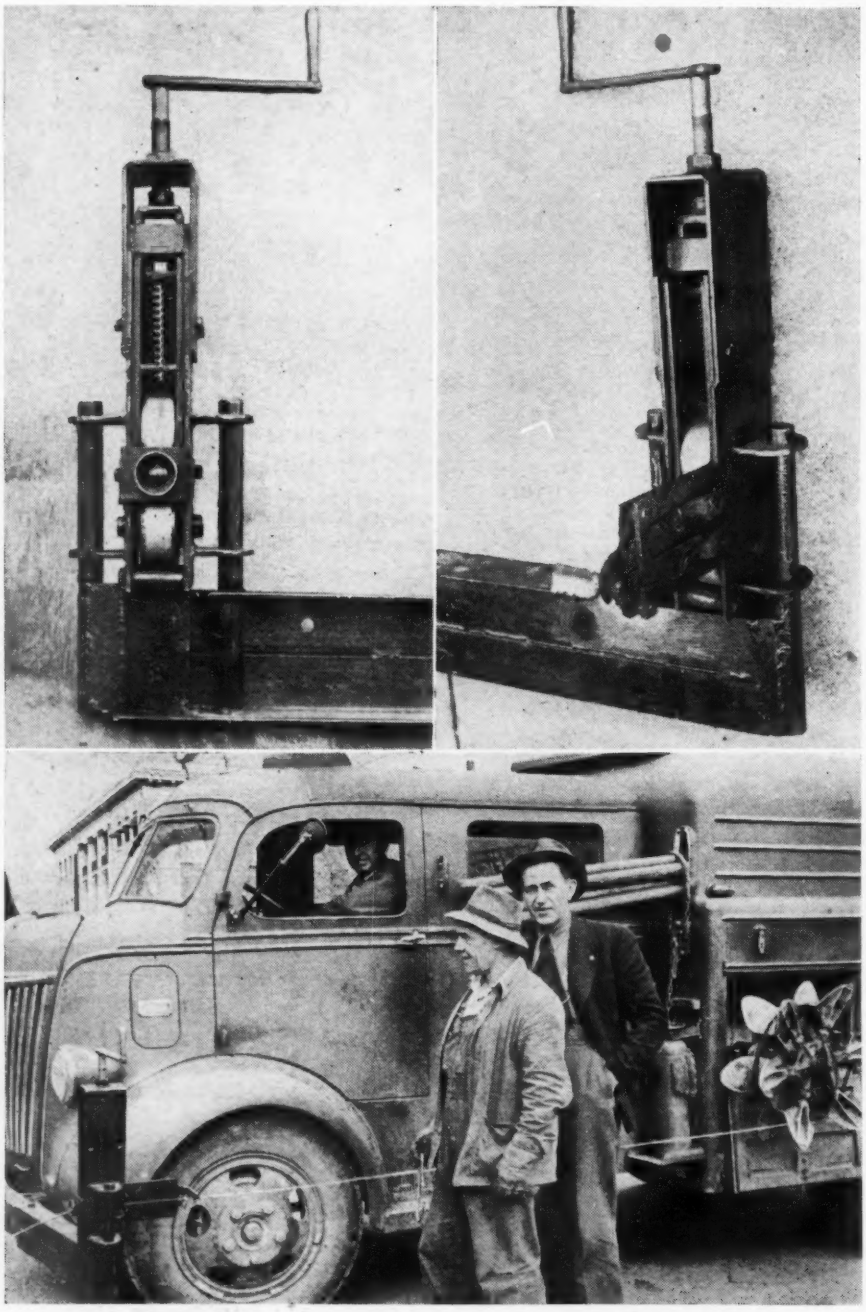
HEADQUARTERS FOR PORCELAIN INSULATION

Stripper Reclaims Old Weatherproof Wire

W. H. BLANKMEYER, Montana Power Co., Butte

THE POWER-OPERATED wire stripper illustrated was designed to reclaim ragged wire during shortages. The original idea by Harry McCann and Frank Bowers was developed and put into practical form by machinist Glen Shultz, all of Montana Power Co.

The stripper consists essentially of two rollers made of 4-in. O.D. ball bearings mounted with an adjustable spring tension setting. A machined guide-cone centers the wire as it passes between the rollers. By properly setting the crank adjusted roller tension, the insulation is pressed flat, much as a lineman's plier is used. After passing the squeezing rolls, a pair of notched, hardened wipers press against the wire, also by spring tension, to scrape the wire clean in one operation. A single locking pin holds the entire stripper assembly on the truck bumper. Lifting out this pin allows the machine to be taken off for storing.



OLD weatherproof wire is reclaimed by truck-mounted stripper (lower) as it is coiled up on power-driven take-up reel. Upper left view shows guide-cone, rollers and spring adjustment. Spring-mounted scraper bars (upper right) remove insulation after wire has passed through rolls

Winch power is used to pull the wire through the stripper as shown in the lower illustration. Wire to be reclaimed can be cleaned as it is reeled in at the job or it can be taken from another feeder reel. Wire sizes from No. 8 to No. 2 have been reclaimed with equal efficiency. Speed of handling is at the rate of one to two miles per hour.

Due to the accurate, yet flexible, spring tension adjustment, the splices pass through without breaking or catching and the wire has no visible scratches or dents as a result of passing through the machine.

•

It Pays to Cut Core Loss of Rural Transformers

MAX W. ROTHPLETZ
Rural Electrification Administration
Washington, D. C.

EVEN if only minor increases in efficiency of rural transformers can be expected and the combined losses must remain at about present values, the ratio of core to copper loss can be manipulated somewhat to achieve lower total energy losses over a period of time. Nevertheless it may not be practicable to design for the lowest energy losses because the cost of equipment may be increased to the extent that fixed charges are increased more than the variable charges are reduced. A formula has been derived to show the relationship between core and copper losses and the additional money which may be spent on equipment to obtain the desired characteristics.

Since copper losses vary as the square of the transformer load, the total energy losses depend on the load curve. If instantaneous values of copper losses are calculated for a particular load curve, a loss curve may be

Modernize with Philco

GET EXTRA YEARS OF DEPENDABLE SERVICE WITH MODERN PHILCO FLOTÉ BATTERIES

For the expanded power needs of the years ahead Philco is ready with a selection of modern Storage Batteries, engineered for this specialized service. These incorporate the advanced Philco Floté grid . . . a special development for full float service which eliminates low cells, reduces internal losses and adds greatly to battery life. Specify modern Philco Floté Storage Batteries, in Steel Glass, Rubber or Vitrabloc jars. Write for new catalogs giving specifications.

PHILCO CORPORATION
Storage Battery Division, Trenton 7, N. J.
Makers of the famous Philco "Thirty"

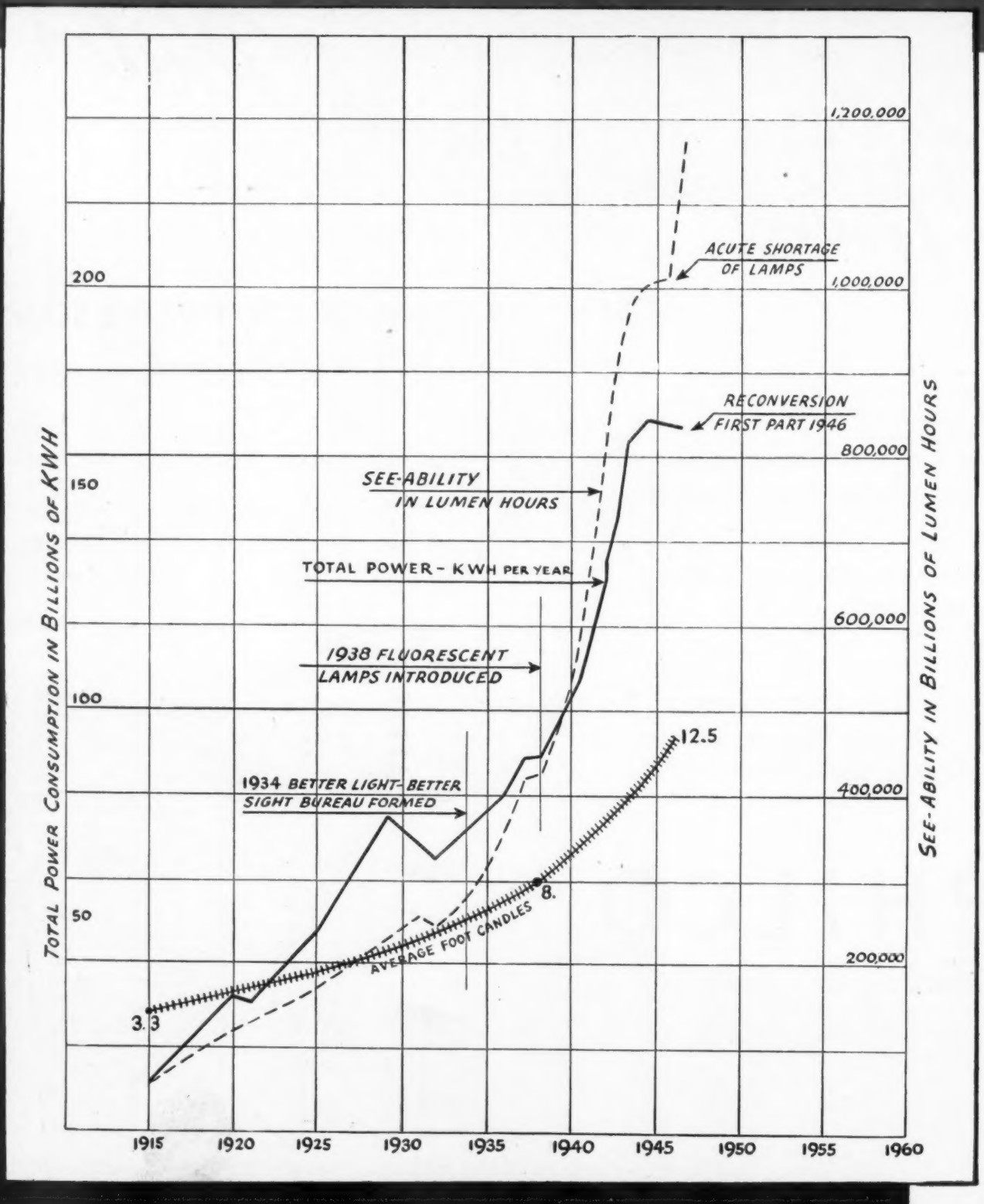
PHILCO

Famous for Quality the World Over

FOR FIFTY YEARS
A LEADER IN
INDUSTRIAL STORAGE BATTERY
DEVELOPMENT

Philco Floté Control Battery in annealed Steel Glass Jar.

Good lighting is contagious



Increasing public acceptance of higher levels of light means a new opportunity for building lighting load.

The accompanying chart tells the story. The solid black line represents power sales, which have increased steadily and with an accelerated rate since 1937. The cross-hatched line shows average footcandle intensity in homes, stores, offices and factories.

These two elements alone, however, do not give a complete picture because the power curve includes more than lighting load and the average footcandle curve does not take into consideration the dimension of *hours of use*. Consequently we have introduced the measure, *lumen hours*, shown as a dashed line on the chart.

Lumen hours are the product of three factors—the total industry sale of light sources *times* the lumen output of these sources *times* burning hours. We believe that this represents a truer measure of "See-ability" bought and used for all purposes.

LUMEN HOURS FOLLOW THE POWER CURVE

Note how the lumen-hour curve follows the power curve and how the rate of increase today exceeds that of the power curve. To us this means that the public demand for more light is just beginning to hit its stride . . . that the future will see a lighting load far in excess of present day expectations.

The curve of lumen hours, because it includes the hours-use dimension, clearly indicates that when people experience the See-ability afforded by a higher level of light they just naturally use more of it. They turn lights on earlier and keep them burning longer.

GOOD LIGHTING IS CONTAGIOUS

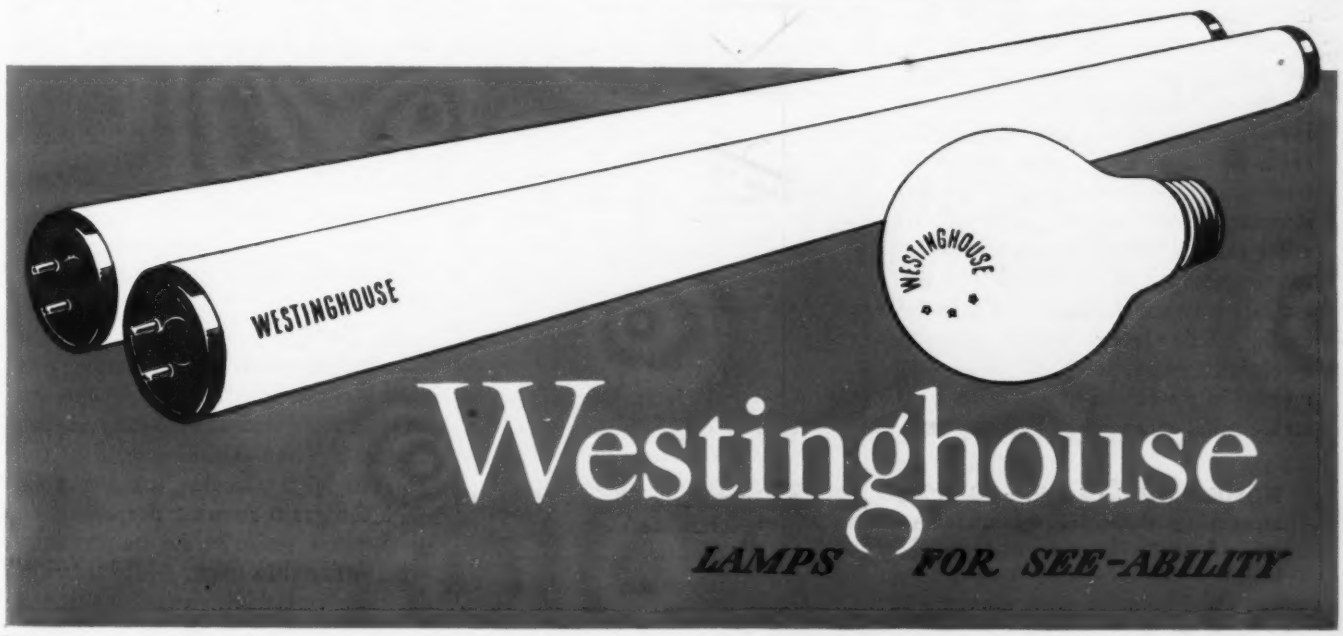
Further reference to the chart shows that the lumen-hour curve increases in geometrical progression as the footcandle curve rises. Why? *Because good lighting is contagious.* Increased See-ability in one office, one section of a store, one department in a factory or one room in a school is not restricted to that one locality long. People moving from a well-lighted to a darker area notice the difference, and soon the levels in adjoining areas are raised.

This trend toward use of ever increasing amounts of light has been caused by a number of factors. Chief among them are lowered cost of power, lower cost of lamps, greater efficiency of lamps, and greater public acceptance of the benefits of proper lighting.

There is one thing we should not overlook in studying these curves and planning for the future. Public acceptance and continuing spread of good lighting require the nourishment of promotion and selling effort to keep them growing.

Now is the time to lay the foundation which will permit an all-out selling program when supplies of equipment permit. Now is the time to be training sales personnel, to pre-sell the market, and to organize the sales campaigns that are the final pay-off. Lamp Division, Westinghouse Electric Corporation, Bloomfield, N. J.

It is generally agreed that 50 footcandles is a practical and economic level to use as a standard for good lighting practice today. This has been reached by a few progressive industrial and commercial organizations. But the over-all average of 12.5 footcandles today leaves a market more than four times as great still to be developed.



drawn from which a "loss factor," showing the ratio of average losses to peak losses, may be derived.

Then if

L = loss factor in percent
R = energy costs in cents per kw.-hr.
F = fixed charges in percent.
C = decrease in core loss in watts
W = increase in copper loss in watts at peak load

$$P = \left(C - \frac{LW}{100}\right) 8.76 \left(\frac{R}{F}\right) \text{ dollars}$$

in which P = justifiable additional investment in dollars.

Thus assuming a loss factor (L) of 10.9 percent, $R = 0.9$ cent, $F = 10$ percent, an additional transformer investment of $0.70 would be justifiable if core loss (C) could be decreased 1 watt in conjunction with a 1-watt increase in copper loss at peak load. If the design required that copper loss be increased 2 watts while core loss be decreased 1 watt, the justifiable increase in investment per transformer would be $0.61.

If a transformer load curve is not available for determining the loss factor, the load factor can be used in the formula to calculate a figure somewhat lower than the maximum additional investment that can be justified; for purposes of simplification, this figure is called the minimum justifiable additional investment. The load factor of the transformer used in the above example was found to be 23.4 percent. Using the same assumptions as above, a minimum additional investment of $0.60 would be justifiable if the core loss was decreased by 1 watt with an increase of 1 watt of copper loss at peak load. If copper loss was increased 2 watts for 1-watt decrease in core loss, the minimum justifiable additional investment would be $0.42.

Thus, in selecting a transformer size for an individual load, it is important to make sure that it will not be too large for a long time to come, not only on account of the first cost, but also on account of the core losses. For example, a 1-kva. transformer is estimated to cost $34.00. A 1½-kva. conventional transformer costs about $39.00. If the load is not expected to exceed 1 kva., the 1½-kva. size would represent an unnecessary investment of $5.00. Furthermore the full load losses of a 1-kva. transformer are about 10 watts core and about 50 watts copper; at 1-kva. load the losses of a 1½-kva. unit are about 21 watts core and 20.5 watts copper. Based on the same assumptions as in the previous example, using the 1-kva. transformer provides a saving in losses equivalent to saving a further additional investment of $6.13. If saving in losses had been calculated on basis of the load factor of 23.4 percent, a minimum savings in investment of $3.24 would have been indicated.

Importance of core losses of rural transformers can be sensed from data on two rural systems with 525 and 1,025 miles of line, 1,300 and 2,400 consumers and 24.8 and 21.3 percent system losses respectively. Core losses of the distribution transformers constitute 64.3 and 60.3 percent of the total losses. Distribution transformer copper losses are 9.2 percent on both systems. Substation transformers account for 12.5 and 12.2 percent, meter core losses 4.2 and 3.3 percent, line and miscellaneous losses 9.8 and 15 percent.

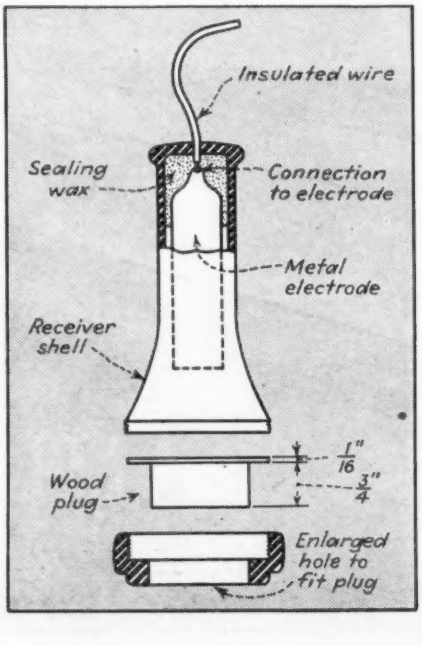
• • •

Half Cell for Measuring Corrosion Potentials

J. M. STANDRING
Operating and Engineering Dept.
American Telephone & Telegraph Co.
New York, N. Y.

IN CORROSION TESTING WORK on underground structures it is frequently necessary to determine the potential of the structure with respect to the surrounding earth. This test involves making a contact with the earth in some way. Sometimes electrodes of the same materials as the structure under test are employed. In other cases a half cell is used in order to minimize the effects of galvanic potentials between the electrode and the earth. This latter device consists essentially of a piece of metal immersed in a solution of one of its own stable salts, arranged so that the earth contact is made with the salt solution rather than with the metal. In this way the electrode is made to carry its environment with it.

Many investigators make up their own half cells to suit their own special needs and have shown considerable ingenuity in adapting readily available parts for this purpose. Basically all that is needed is an insulating housing for the metal electrode and the solution with some sort of a porous plug which will become saturated and form the earth contact. The particular half cell which is described here makes use of a discarded telephone receiver shell and associated cap although, as will be evident, any other non-metallic housing of suitable size and shape might be used. Reference to the accompanying illustration indicates the idea.

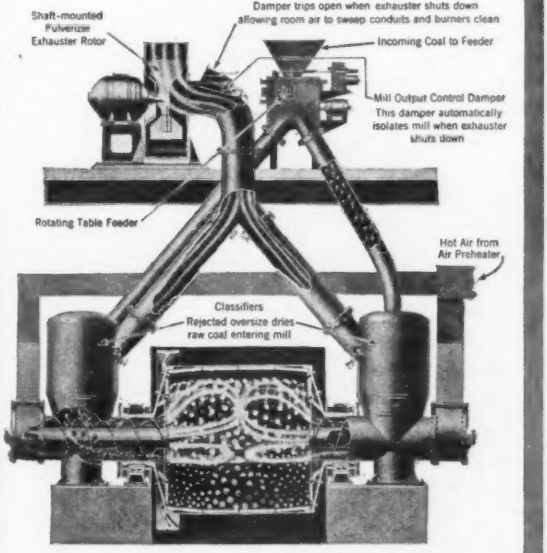


HOME-MADE half cell, used in measuring potential on underground structures to ground, uses telephone receiver shell for housing, wood plug for earth contact

In the assembly of the unit, the metal electrode to which a connecting lead is attached is sealed into the end of the receiver shell by means of sealing wax. The business end of the cell consists of a circular wooden plug, with the grain running perpendicular to the axis, made in the manner indicated. The thin upper lip of the plug is made just thick enough to permit

by PUBLIC SERVICE ELECTRIC AND GAS COMPANY of NEW JERSEY

In 1937, Public Service Electric and Gas Company of New Jersey ordered four Foster Wheeler ball mill pulverizers for the Essex Station. Since then, as additional generating capacity has been added at Essex and other stations, FW ball mills have been selected to fire the new steam generators. Now, to supply vastly increasing power demands, Public Service is building another station at Sewaren. When this goes into service, six FW ball mills will serve its two steam generators, bringing to 25 the total of FW pulverizers in this Company's stations.


Shaft-mounted Pulverizer Exhauster Rotor
Damper trips open when exhauster shuts down allowing room air to sweep conduits and burners clean
Incoming Coal to Feeder
Mill Output Control Damper This damper automatically isolates mill when exhauster shuts down
Rotating Table Feeder
Hot Air from Air Preheater
Classifiers
Rejected oversize dries raw coal entering mill

SEWAREN . . . Six FW ball mills will go into this new station. The phantom drawing shows the double classifier, single feeder and exhauster type mill arrangement.

Records show that operators of FW ball mills enjoy high availability, low maintenance costs. One example — a single mill pulverizing coal of 50-55 grindability was in continuous service 8403 hours, had a yearly availability of 99.03%. In that period it handled 30,371 tons of coal at a total maintenance cost of 1.07 cents per ton.

FOSTER WHEELER CORPORATION • 165 BROADWAY, NEW YORK 6, N.Y.

FOSTER WHEELER

BERMICO*
FIBRE CONDUIT

FOR SUREST CABLE PROTECTION---
SPECIFY BERMICO CONDUIT

1 **LIGHT.** Easily handled on the job; one man can carry several 8-foot lengths at once—lay more per working hour.

2 **TIGHT.** All joints are precision milled for tight, speedy, installations.

3 **STRONG.** Bermico Conduit is engineered to take the shocks and stresses of transport . . . the heavy loads imposed during installation.

4 **NO SPLIT COUPLINGS.** With Bermico's specially designed couplings, you end the expense—the loss of time required to replace broken couplings.

5 **WATER PROOF.** Bermico's water absorption factor is extremely low—its insulation factor extremely high, even under toughest conditions.

6 **ACID RESISTANT.** Resistant to soil acids and alkalies, Bermico Conduit is, itself, chemically inert.

7 **SMOOTH INSIDE BORE.** Quick and easy cable "pull throughs"—without danger of abrasions—when you're using Bermico *inspected* conduit!

8 **UNIFORM.** Four rigid factory inspections guarantee Bermico's uniformity of dimensions, specifications and quality.

distributed by
WESTINGHOUSE ELECTRIC SUPPLY COMPANY
Offices in all leading cities

* Reg. Trade Mark

BERMICO FIBRE CONDUIT—A PRODUCT OF BROWN COMPANY

it to be held in place against the shell by means of the receiver cap. This plug may be turned on a lathe or can be made of two disks held together with a water-proof glue. If glue is used it should be confined to a band around the larger disk so as not to water-proof the central section through which electrolytic conduction must take place. White pine has been used for the plug and it appears to perform satisfactorily. After filling the cell with the desired salt solution, a small amount of lacquer placed around the lip of the shell will make a gasket for the wood disk. The cap should be assembled before the lacquer hardens.

Cells of this general pattern have been made up using lead as the electrode and a saturated solution of lead chloride as the electrolyte. Other combinations, such as copper and copper sulphate, might be used, depending on the test requirements. The resistance of the lead chloride cells has been in the order of 200 to 500 ohms between the electrode and the face of the wood plug. However, because of the possibility of high resistance in the contact between the cell and earth, a voltmeter having a high internal resistance should be employed with electrodes of this type. Vacuum tube voltmeters or direct indicating instruments with a resistance of about 200,000 ohms per volt are suitable. Ordinarily the potentials to be measured are in the range of 0 to 1.0 volt.

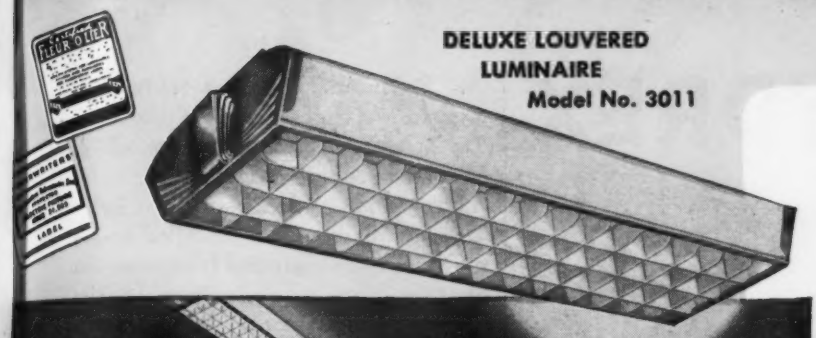
These cells are not intended to be precision devices, but the ones that have been made appear to be stable over a period of several months if the electrolyte is not allowed to evaporate. Evaporation can be retarded by covering the ends of the cell with tape when not in use.

•

Light Fixtures Facilitate Air Duct Cleaning

THE VENTILATING PASSAGES in air-cooled transformers occasionally become clogged with particles carried in the cooling element, and someone then has to crawl into the air duct under the transformer with an air hose to loosen and remove the accumulation.

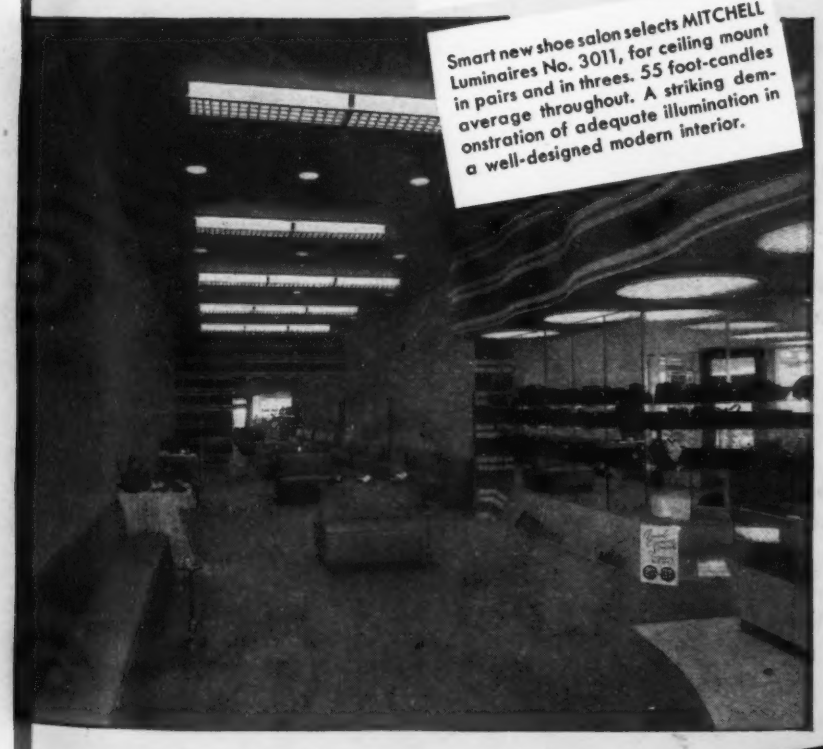
Working in the cramped quarters of the air duct, with the air hose getting tangled frequently in the extension cord of a drop light, gave Martin



DELUXE LOUVERED
LUMINAIRE
Model No. 3011

Better Light for Better Business ..by MITCHELL

Modern radio and appliance shop, Chicago, features MITCHELL DeLuxe Louvered Luminaire No. 3011, in continuous row mount. 55 foot-candles average, maintained. Note the no-glare, evenly diffused illumination.



Smart new shoe salon selects MITCHELL Luminaires No. 3011, for ceiling mount in pairs and in threes. 55 foot-candles average throughout. A striking demonstration of adequate illumination in a well-designed modern interior.

Better light by MITCHELL is building better business for these progressive shops as well as for sales-minded businesses everywhere. MITCHELL-engineered Luminaires deliver "selling" light . . . abundant high-level illumination, skilfully shielded for glareless, natural effects. MITCHELL Luminaires create and maintain a "sales atmosphere" that attracts customers, puts appeal into merchandise, makes it more desirable and easier to sell. That's why progressive businessmen prefer MITCHELL Commercial Lighting.

This tremendous user acceptance builds better business for the wholesaler. MITCHELL sales are clean, package transactions—trouble-free volume business. MITCHELL installations are easy, smooth jobs for the contractor—time-saving, profitable business. And utility men find in MITCHELL installations the high-level, properly diffused illumination recommended for really adequate lighting. From every angle, MITCHELL is Better Light for Better Business . . .

MITCHELL

Mitchell Manufacturing Company
2525 CLYBOURN AVENUE, CHICAGO 14, ILLINOIS
For West: *Complete Modern Plant and Sales Office at Los Angeles*
Serves the Entire Pacific Coast Area
1019 NORTH MADISON AVENUE, LOS ANGELES 27, CALIFORNIA

Makers of Commercial and Industrial Fluorescent Lighting Equipment
Store Window Lighting • Spotlights and Floodlights • Desk Lamps • Portable Floor and Table Lamps • Bed Lamps • Ultraviolet and Infrared Health Lamps • Residential Lighting Specialties . . . Rad-i-Air Germicidal Units (made by Tru-Air Ultraviolet Products Co., Los Angeles)

Simplex-ANHYDREX UNDERGROUND CABLES

FOR USE WITH OR WITHOUT DUCTS

- COPPER CONDUCTOR
- ANHYDREX INSULATION
- TAPES AND FILLING
- HARD SERVICE JACKET

Easy to....

- SPLICE
- INSTALL
- TERMINATE
- MAINTAIN

Simplex-WIRES & CABLES

SIMPLEX WIRE & CABLE CO. 79 SIDNEY ST. CAMBRIDGE 39, MASS.

S. Robinson, assistant substation operator of Consolidated Edison Co. of New York, Inc., an idea which earned a suggestion award.

He proposed that permanent lighting fixtures could be installed inside the duct and controlled from a switch outside. By properly placing the lights, every channel in the transformer is illuminated and the need for the drop light is obviated. Inspection of the transformer is facilitated and the complication of clearing entangled air hose and cord eliminated.

•

Lightning, Grounds and Fuses on Rural Lines*

G. J. WILLIAMS

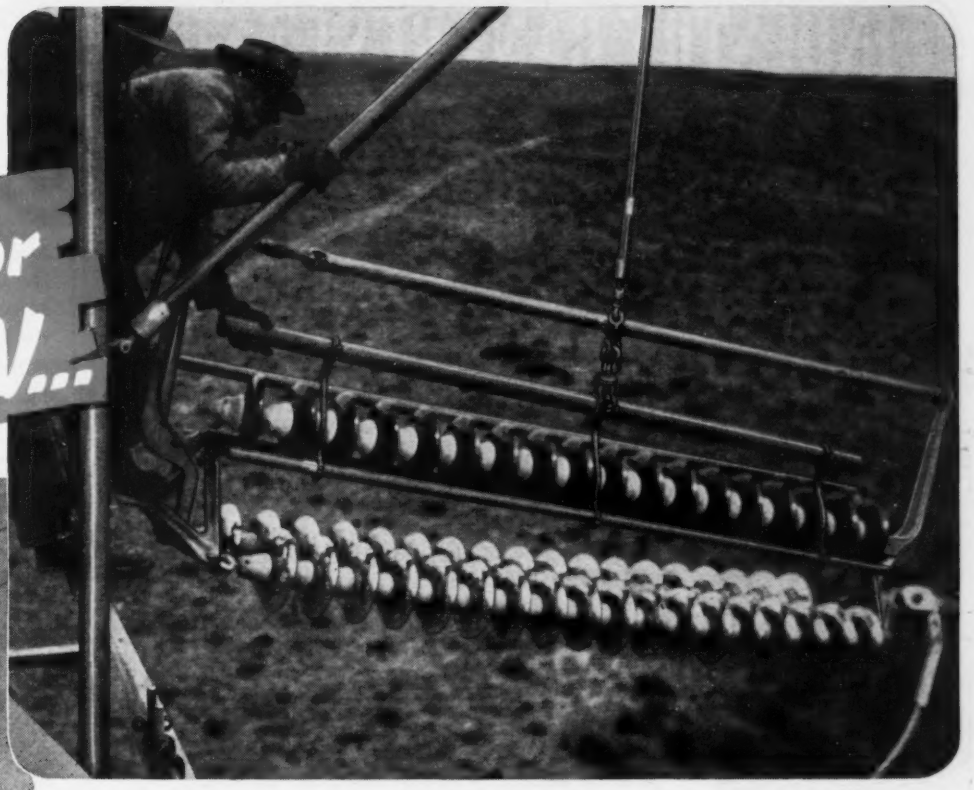
Division Manager
Connecticut Light and Power Co.
Willimantic, Conn.

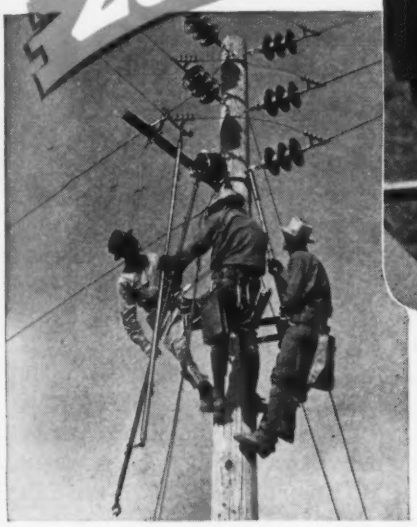
DUE TO THE SEVERITY of lightning storms in the area served by Connecticut Light and Power Co., considerable study has been given to the type of transformers used and method of installation. Grounding is specially emphasized. Two 10-ft. rods are driven to ground the secondary neutral of the transformer and two 10-ft. rods for lightning protection. On individual transformer installations a set of grounds for lightning protection is installed at the transformer pole, keeping the rods at least 6 in. apart, and driving on a 30-deg. angle for maximum separation. The second set of grounds for the neutral conductor is installed at least 20 ft. from the pole in a similar manner. Where secondaries are involved, the ground is installed on the adjacent pole.

On branch lines, transformers are usually connected directly to the line without the use of fusible cutouts. One primary lead of the transformer is connected with a split bolt conductor, the second being connected with a tap clamp permitting removal under load using an insulated clamp stick. For protection of such branch lines, fusing is installed at the point where the line is tapped to the feeder. As a minimum a 20-amp. fuse is provided in transformer installations. Sizes for transformer and line fuses have been standardized at 20, 40, 75 and 100 amp.

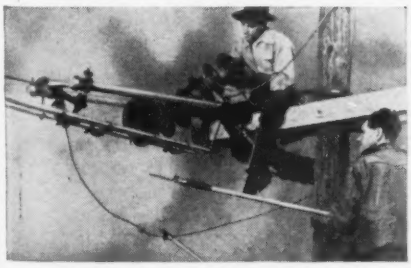
To protect lines and transformers,

*From a paper before the seventh New England Rural Electrification Institute, Amherst, Mass., April 17, 1946.

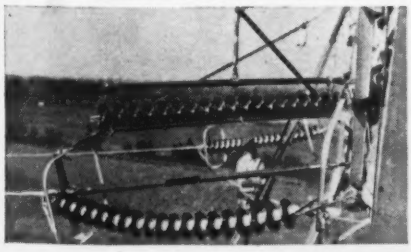




Dead end insulators on poles or crossarms (up to 16 KV) can be changed in a matter of minutes with this handy dead end tool.



For higher voltages use the above two-pole strain carrier and cradle combination for single strings. The single pole strain carrier below is made to handle double insulator strings.



DEFECTIVE INSULATORS are replaced HOT with CHANCE (TIPS) TOOLS!

The illustration above shows how Bonneville maintenance crews quickly replace damaged insulators on the 2700-mile, high-voltage Bonneville-Grand Coulee system. One single-circuit dead end tower has six triple string insulator assemblies, or a total of eighteen strings of eighteen insulator units each. With Chance (Tips) Tools, a single crew changes all insulator strings on a tower in 12 hours actual working time.

Whether *your* line maintenance problem is large or small... whether you service thousands of miles of high-voltage circuits or a small rural line, Chance (Tips) Tools make it possible to replace dead end insulators without interrupting service, and with utmost simplicity and safety.

All Chance (Tips) Tools are tested to withstand 75,000 volts per foot of pole. They are available for all types of live line maintenance.

C4613

A·B·CHANCE CO·
CENTRALIA, MISSOURI.
SAN FRANCISCO, CALIFORNIA

ABC INDUSTRIES

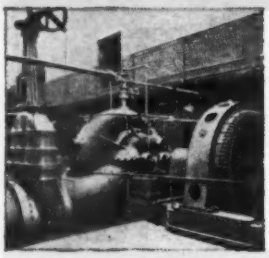
INDUSTRY BANS RUST AND CORROSION *with* Everlasting Fastenings

Few industries can escape the destructive effects of rust and corrosion but *all* industries can reduce their costly ravages in maintenance and breakdown.

Here are five industrial applications where Harper's EVERLASTING FASTENINGS have licked rust and corrosion.

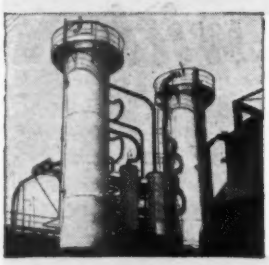
MONEL STOPS CORROSIVE CHEMICALS

Problems in salt production have been solved by using Monel bolts. In mining, treating and handling of many chemicals, non-ferrous alloys are the answer to efficient operation.



BRASS GUARDS WATER SYSTEMS

In valves and pumps that compose the heart of water works, Brass fastenings help in eliminating the most common cause of replacement—rust.

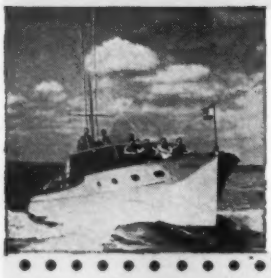


STAINLESS STEEL SOLVES OIL PROBLEMS

Acids and gases at high temperatures attack metal but Stainless Steel alloys cut refinery replacements to a minimum, assure years of continued operation.

UTILITIES CHOOSE SILICON BRONZE

Weather is the bug-a-boo in power lines and other utility applications. Silicon Bronze Bolts reduce season "cracking" and maintenance costs.



NAVAL BRONZE WINS ON SEA

Marine applications demand high strength plus resistance to salt air and water. Naval Bronze fastenings have proved their dependability in marine diesels and ship fittings.

Call upon Harper to solve your fastening problems in your industry.

THE H. M. HARPER COMPANY
2611 Fletcher Street, Chicago 18, Ill.
Branch Offices: New York City, Philadelphia, Los Angeles, Milwaukee, Cincinnati, Dallas
Representatives in Principal Cities

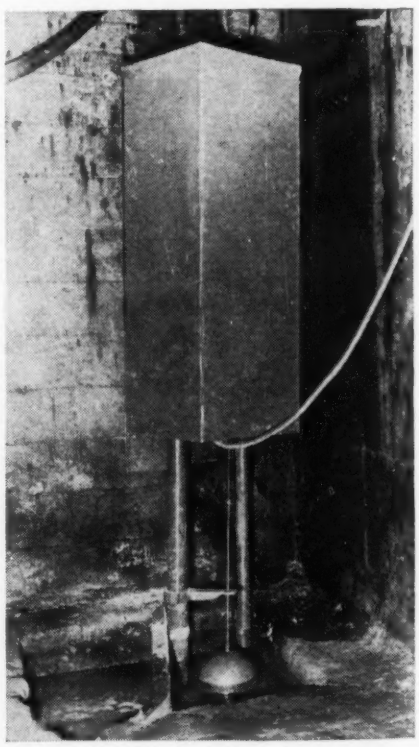
HARPER
Everlasting Fastenings
Chicago

breakers are installed at the substation with line sectionalizing fuses in the main feeder. Such fuses are often of the repeater type and individual protection on the lateral line junction offers a practical solution to over-current faults. After the engineering layout is made for rural lines in an area, a short-circuit study is made of the individual feeders, permitting fuse selection on the basis of their time-current characteristics. This gives a coordination of fusing which will allow the section in fault to clear itself and minimize interruptions.

•

Diving Bell Principle Protects Sump Pump

OCCASIONALLY a manhole sump pump control fails to function or for some other reason the pump becomes inoperative. To protect the motor and control from being submerged and damaged under such conditions, L. W. Carlson, Pacific Gas and Electric Co. cable splicer, Oakland, Calif., hit upon the diving bell principle. A square steel can or hood, airtight on top but open at the bottom, is placed over the pump as shown. This does the job effectively and inexpensively.



STEEL diving bell type hood placed over sump pump prevents motor and control from being flooded in case pump fails to operate for any reason

now!

"Pants" that go on in Seconds–not Minutes for Built-in Heater Cord

Don't be satisfied with slow hand-wrapping methods to provide the supplementary insulation required by the Underwriters' for built-in heater cord.

Get out your stop watch and discover the time and labor savings possible with BH Non-Fraying Fiberglas Sleeving. With "pants" of BH Non-Fraying Fiberglas Sleeving, there are no threads to break or unravel. No possibility of a partly uncovered braid. No training period necessary for workmen.

This is all you do: Fit one BH Fiberglas Sleeving snugly over each asbestos-covered lead. Fit a larger BH Fiberglas Sleeving snugly over the braid. There is no hardening varnish or lacquer in BH Fiberglas Sleeving—it stays flexible as string, will not split or crack when bent. Recent assembly tests have shown savings of three minutes in the insulation of a single heater cord.

BH Non-Fraying Fiberglas Sleeving is made in all standard sizes and colors, in standard 36" lengths and 500' coils, or it may be supplied in short lengths to meet specific requirements.

Test BH Fiberglas Sleeving in your own plant, in your own product—under actual service conditions. Learn why America's leading appliance manufacturers use BH Fiberglas Sleeving for the supplementary insulation on built-in heater cord.

BENTLEY, HARRIS MFG. CO., CONSHOHOCKEN, PA.

BH Fiberglas* SLEEVINGS

*BH Non-Fraying Fiberglas Sleevings are made by an exclusive Bentley, Harris process (U. S. Pat. No. 2393530). "Fiberglas" is Reg. TM of Owens-Corning Fiberglas Corp.

USE COUPON NOW

Bentley, Harris Mfg. Co., Dept. W-6, Conshohocken, Pa.

I am interested in BH Non-Fraying Fiberglas Sleeving _____ (size) for _____ (product) operating at temperatures of ____°F. at ____ volts. Send samples so I can see for myself how BH Non-Fraying Fiberglas Sleeving stays flexible as string, will not crack or split when bent.

NAME _____ COMPANY _____

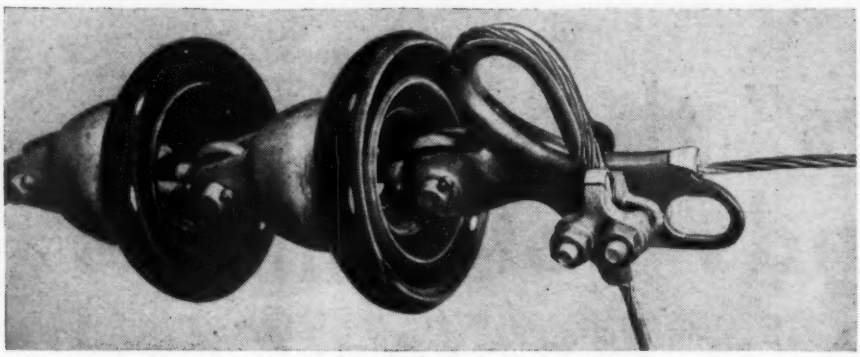
ADDRESS _____

Send samples and prices on other BH Products as follows:

- ☐ Magneto Varnished Tubing Grade "A"
- ☐ Flexible Varnished Tubing Grade "B"
- ☐ Saturated Sleeving Grade C-1
- ☐ Saturated Sleeving Grade C-2
- ☐ Saturated Sleeving Grade C-3

NEW EQUIPMENT

Aluminum Lined Strain Clamp for Use on ACSR



A NEW SPECIAL STRAIN CLAMP for ACSR conductors which is reported to eliminate the need for field-applied armor tape has been developed by the Brewer-Titchener Corp., Cortland, N. Y. The body and keeper of this clamp, No. 2107, are lined with soft aluminum sheet which replaces the need for the armor tape.

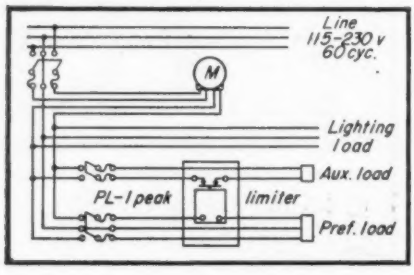
The design of the clamp is similar to the familiar snail-shell snubbing type, but the body is one piece and pressed from $\frac{3}{32}$-in. gage steel. The metal around the connecting pin is extruded to increase the bearing surface on the pin. The keepers are of forged steel with double-wave grip. The company reports that damage to the conductor is prevented by the large snubbing radii, the U-shaped conductor seat, and the long clamping section; that the clamp is hot-dipped galvanized; and that the effects of conductor vibration are minimized by the light weight, short connecting length, and the cable seat radius of 6 in.

Installation of the clamp is reported as particularly simple since a come-along loop is provided and only one clamping bolt has to be removed. It is offered for use only on ACSR within the size range of 0.158 in. minimum to 0.398 in. maximum. The company reports that the use of aluminum liners has been approved by the Aluminum Co. as well as by REA.

•

Device Limits Domestic Peak Demands by Picking Loads

A CURRENT-LIMITING DEVICE which allows the domestic customer the use of all major appliances and at the same time, by picking preferred loads, limits the maximum demand upon the utility system to 20 amp., has been developed by Palmer Electric & Mfg. Co., Wakefield, Mass. The unit is reported to provide the customer the benefit of these modern conveniences and at the same time to provide the utility the opportunity of serving them without additional metering, without time-limiting devices, and without an excess peak-demand factor in billing.



The limiter is illustrated, schematically, in a typical home where the installation consists of a water heater, range and lights. It can be hooked up to take care of a mangle, air-conditioner, or other heavy current-consuming appliances as well as those previously mentioned.

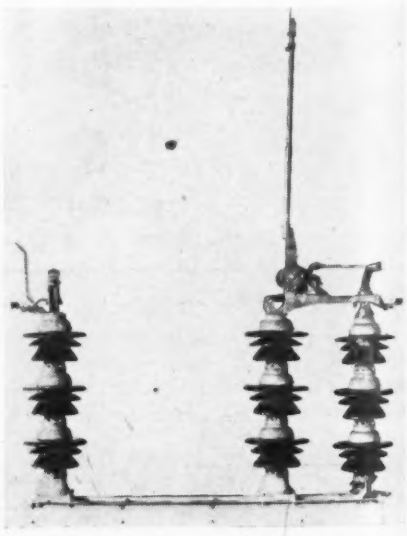
The function of the unit is to relieve the service entrance equipment and the power supply source from excess demand loading, and, without limiting their normal use, permits the installation of additional convenience devices on what might otherwise be inadequate service wiring. It also relieves the power company from the expense of maintaining "standby" service to supply power to meet uncertain excess peak load conditions. In the hook-up illustrated, when the range load (shown as the preferred load) builds up to 20 amp., the hot water heater (shown as the auxiliary load) is automatically disconnected. When the range load drops back to 10 amp. the hot water heater is automatically cut back into the circuit. Peak demands are thereby limited as they would be if mangle and air-conditioning loads were later added to auxiliary circuit.

Limiter is installed in an $8\frac{3}{8}$ x $5\frac{3}{4}$ x 4-in. cabinet and consumes less than 3 watts at any point in the load cycle. The company reports that the unit has been approved, and that, in operation, it does not occasion detectable radio interference. It is available for single or polyphase services.

•

115-Kv., 600-Amp. Switch Features Locking Blade

A NEW TYPE CH, high-pressure, group-operated switch for 115 kv., 600 amp., has been designed by Southern States Equipment Corp., Hampton, Ga. It has weather-proof, greaseless bronze ball bearings and is designed to withstand short circuit currents of 1 sec. and 5 sec. It carries a rated load without exceeding a temperature rise of



ANNOUNCING HUBEYE!

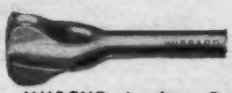
The Answer to Guying Requirements

End view showing Side Wall Support of Strand by Hubeye design.

Side view showing lay of Strand in Hubeye. Fully Rounded Bearing Area is provided.

After many years of experience in producing forged eyes of all types for use without thimbles, Hubbard and Company has developed and established as its standard, the HUBEYE. This eye has received immediate approval from all Standards Engineers to whom it has been shown. Due to its universal appeal Hubbard and Company has concentrated on this design as standard for all eyes on products which involve attachments where a no-thimble eye means a saving of time, money and maintenance to users. Most of these items are illustrated or listed here.

Hubeye design consists of a rounded section of large radius around which the guy is looped. High side walls support and maintain its round shape so that no individual wire strands are subjected to excessive strain. The eye is drop forged and is stronger than the rod section from which it is made. All inner surfaces are kept smooth and are protected against corrosion by Hubbard Double-Dip Hot Galvanizing.

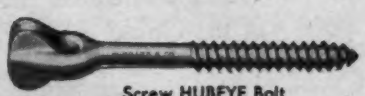


HUBEYE Anchor Rod Threaded or Drive Point and Screw Type Steel-wing.

TU-HUBEYE Anchor Rod Threaded or Drive Point

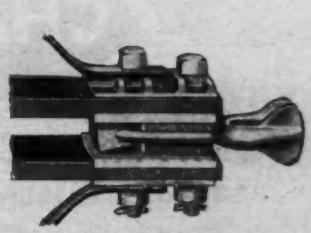
HUBEYE Straight Bolt

HUBEYE Angle Bolt



Screw HUBEYE Bolt

HUBEYE NUT (Threaded)



Wood Strain Insulator HUBEYE Attachment

HUBBARD and COMPANY

Pittsburgh · Chicago · Oakland, Calif.

Two IMPORTANT O.K.'s for this BETTER pole treatment

After years of thoroughgoing test, the facts are proving that Chapman "Penta" Preservative is, on all counts, the most satisfactory treatment for your poles which is available today.

Linemen and others who must work on and with poles prefer this clean treating material, because there's nothing sticky or unpleasant about Chapman "Penta" Preservative.

Actual tests by the Forest Service of the U. S. Department of Agriculture show pentachlorphenol superior in decay and termite resistance to any of the 21 other preservatives—including creosote—used in their 10-year-old exposure experiments. That means lower maintenance costs for you.

Chapman "Penta" Preservative treatment costs no more than creosote, and can be obtained in any part of the United States. Write us for details.

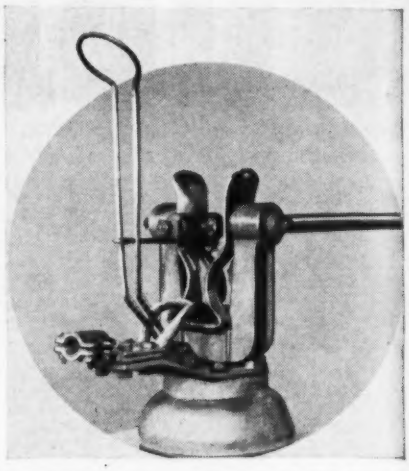
CHAPMAN

CHAPMAN CHEMICAL COMPANY
333 North Michigan Avenue, Chicago 1, Illinois

Chapman "Penta" Preservative contains *Pentachlorphenol*
a product of
The Dow Chemical Company

30 deg. C. above an ambient of 40 deg. C., the company reports. A feature of the switch is the locking blade, the motion of which is accomplished by means of mechanical linkages with fixed bearings.

As the blade moves down to make contact with the jab, the blade operat-



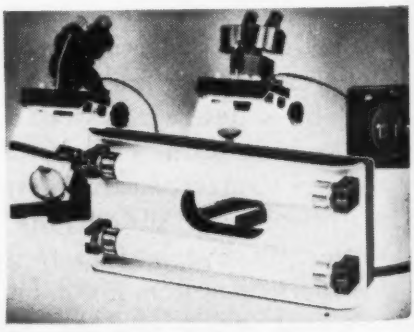
ing mechanism pulls the blade rod backward and at the same time pulls the front shoe backward, thus locking the jaws against the springs in the housing. Pressure of 300 lb. is applied at the contact points.

Tests made under severe icing conditions show the switch operates efficiently with minimum of effort and strain, company engineers state.

•

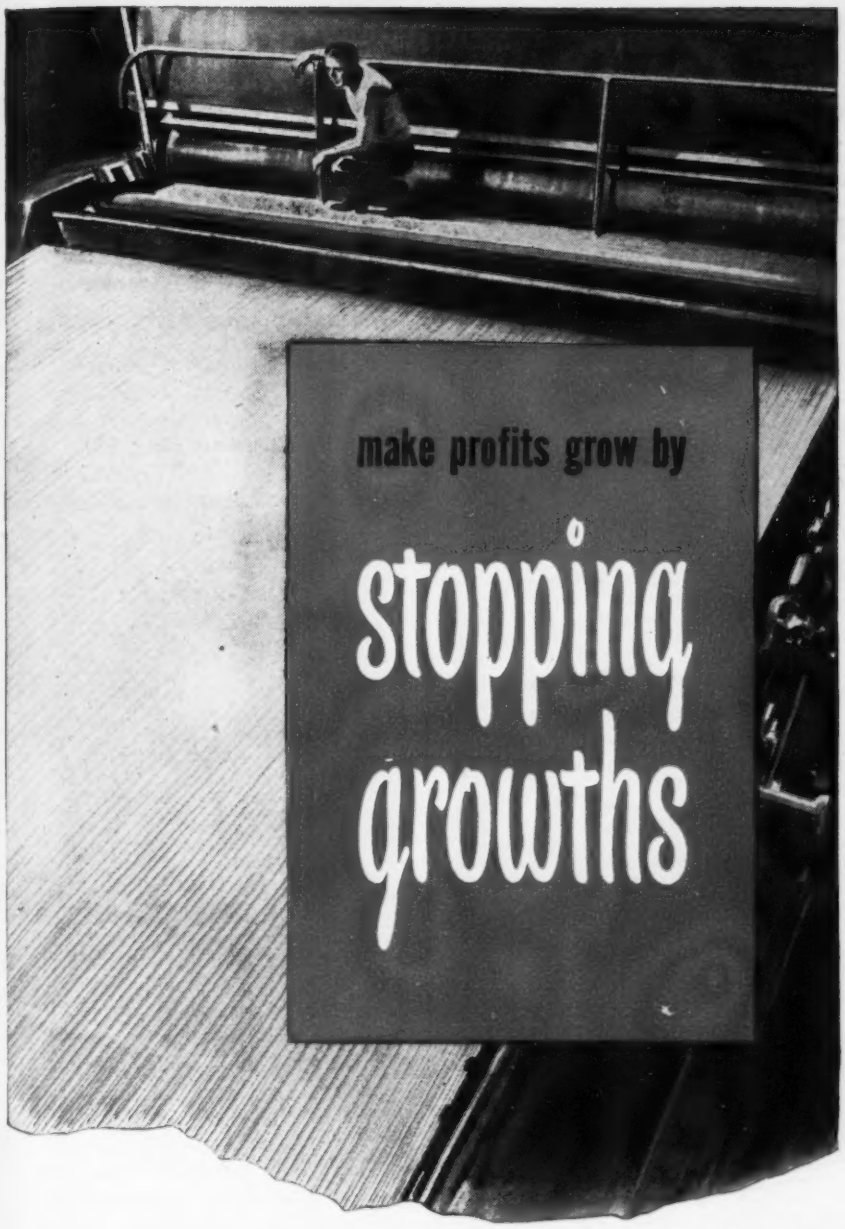
Miniature Fluorescent Produces 450 Foot-Candles

A MINIATURE fluorescent lamp designed as a cool light source of high intensity and uniform field and for direct attachment to most types of microscopes has been developed by Stocker & Yale, Marblehead, Mass. The twin 4-watt fluorescent lamps straddle the



lenses and direct the light upon the subject under scrutiny. Halos and highlights are reported eliminated by the length and separation of the tubes and by the nature of the light itself.

The design produces a light intensity of 450 foot-candles at a 3-in. working distance and a color temperature of 3,500 deg. Kelvin. Operating tempera-



DOWICIDES curb losses of paper

In paper manufacturing—and in other industries where micro-organisms damage materials and decrease output—Dowicides turn losses into profits.

In paper mills, slime flourishes. And slime damage is expensive. Slime causes machine "breaks," defective paper due to spots and holes, and excessive wash-up time.

Conditions fostering slime growth vary. So do organisms causing slime—algae, fungi and bacteria. Control calls for careful analysis of slime types and application of proper killing agents.

Because of their broad effectiveness, Dowicides are widely used in slime control. They cut losses, too, by prolonging wet felt life, preserving adhesives and preventing mildew on lap stock. And they make paper, boxboard and fiber board mold-resistant.

In paint, textiles, lumber, leather—wherever mold, termites or bacteria attack—ask Dow to select a Dowicide for your specific use.

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit
Chicago • St. Louis • Houston • San Francisco • Los Angeles • Seattle
Dow Chemical of Canada, Limited, Toronto, Ontario

CHEMICAL COMMENTS

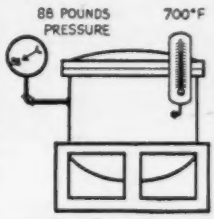
An Effective Thickener for Improved Dye Printing

Methocel, Dow cellulose derivative, has demonstrated unusual possibilities as a dispersing, thickening, and binding agent. One of its important applications is in textile printing. As a thickener for fast color salts and diazotized bases for printing on naphthol prepared grounds, it yields prints of exceptional brightness, smoothness, and sharpness of mark with greater penetration and efficiency of dyestuff. Methocel can be used in dyes either for machine or screen printing.

Coating Fabrics for Chemical Resistance

Saran F-122 Latex, a new Dow material for the textile industry, is used as a coating, sizing, impregnating and laminating agent in the treatment of fabrics. Coated with Saran Latex, fabrics are particularly well suited for industrial use where chemical resistance and durability are important. They can be made resistant to water, oils, greases, gasoline, acids and alkalies in the making of conveyor belting, tarpaulins and other products. Yarn and thread can also be sized with Saran Latex, making them waterproof and resistant to picking and linting.

Flexible Heat for Paint Processing

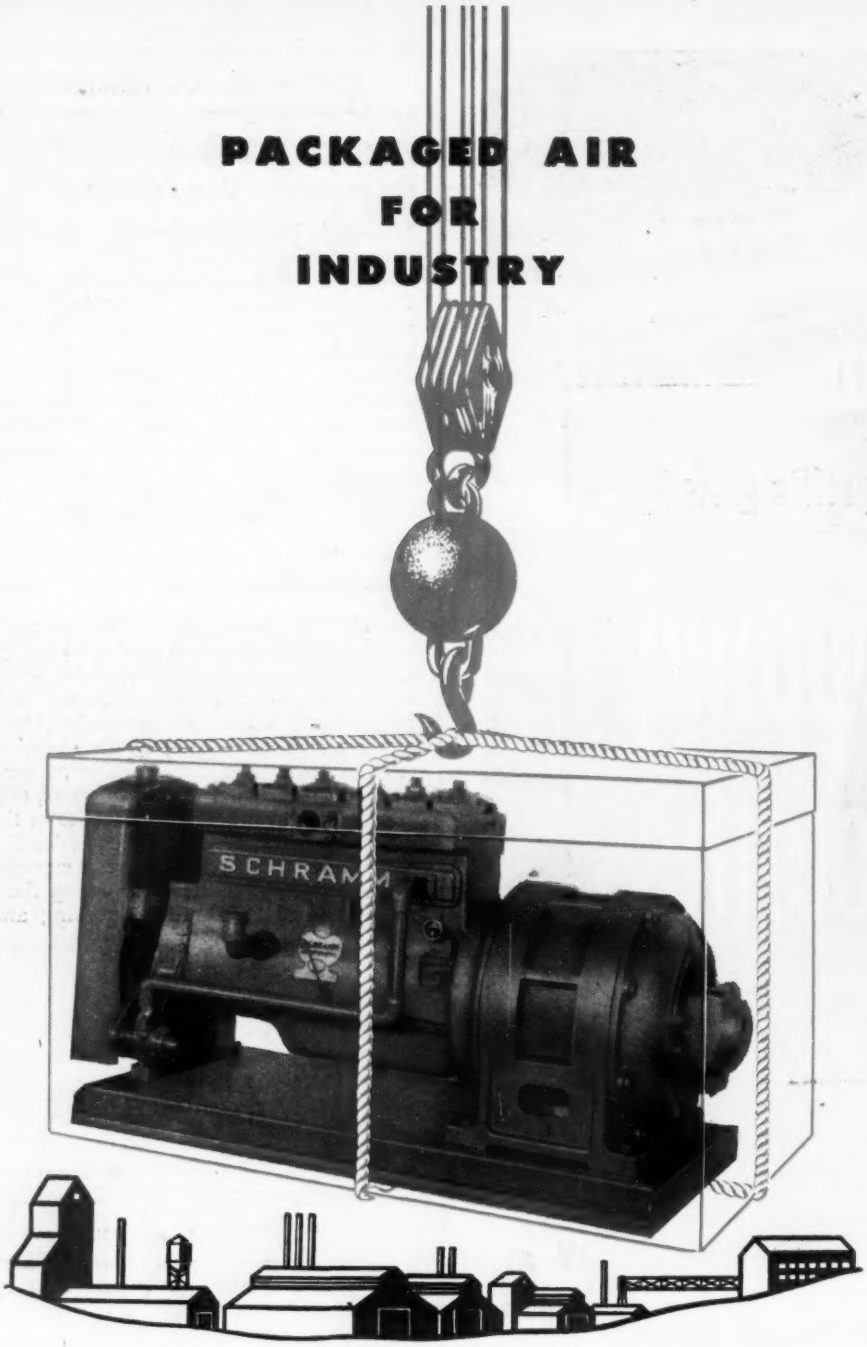


Flexible heating systems are a necessity to many paint and varnish firms, where high-temperature processing requirements vary widely. In one Midwest varnish plant, where processing temperature requirements vary from simple heating to complex sequences of heating and cooling, Dowtherm, the high-temperature, low-pressure heat transfer medium, has been installed. With this indirect heating system temperatures can be adjusted easily for every specific job. The company uses a 3,000,000 btu/hr. Dowtherm vaporizer for heating and an independent liquid-phase Dowtherm cycle for cooling. Simple controls permit the two cycles to be coordinated for a variety of temperature combinations.

DOW

CHEMICALS INDISPENSABLE TO INDUSTRY AND AGRICULTURE

PACKAGED AIR FOR INDUSTRY



Packaged air . . . when and where you need it . . . is always there when you have a stationary or portable Schramm Compressor. Designed for rugged, reliable duty, Schramm Compressors give a continuous flow of air with a minimum of maintenance. Of special advantage to the Industrial Engineer are these Schramm Compressor features:

1. **Completely watercooled to provide ideal performance in winter as well as summer.**
2. **Main bearings for every cylinder.**
3. **Mechanical Intake Valve.**
4. **More cylinders and lighter parts.**
5. **Forced feed lubrication.**

Make your compressed air problems easier by using Schramm Air Compressors. Write today for construction details on these rugged, reliable units.

SCHRAMM INC. THE COMPRESSOR PEOPLE
WEST CHESTER
PENNSYLVANIA

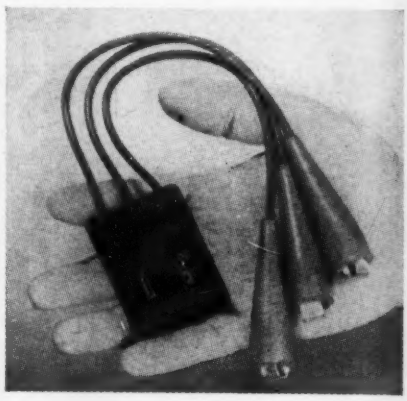
ture of the lamp is 115 deg. F. Bulb has life of 2,500 hours and is used on 115-volt, 60-cycle circuit.

Lamp dimensions are 1⅜ in. high, 2¾ in. wide, and 6¼ in. long. Several styles of attaching brackets are available for various instruments.

•

New Testing Instrument Performs Six Functions

A NEW INSTRUMENT, which indicates (1) phase rotation, (2) a.c. or d.c., (3) positive or negative on d.c. without going to ground, (4) 220 and 110 volts a.c. or d.c., and (5) will identify all wires, high phase and lighting phase



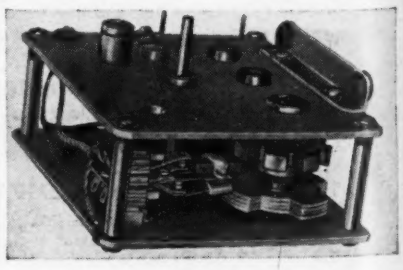
in a 4-wire combination system, as well as (6) locate blown fuses, has been announced by Robert C. Rindfleish & Associates, Engineering Bldg., 205 West Wacker Dr., Chicago 6, Ill.

It is called the "Polyvoltester" and indicates phase rotation by "left" or "right." The instrument cannot be damaged by improper connection to any of the above mentioned systems and will give satisfactory results on frequencies considerably lower and higher than 60 cycles, it is stated.

•

Constant Speed D.C. Motor Utilizes Vibrating Reed

AN IMPROVED MODEL of the constant speed d.c. motor, which, according to the manufacturer, virtually antiquates the year-old original, has been developed by the Amglo Corp., 4234 Lincoln Ave., Chicago 18, Ill. The new model utilizes the principle of polarized mag-



HOW TO MAKE POLES LAST LONGER

Just off the press. A factual booklet describing 12 years field experience with OSMOPLASTIC in ground line treatment of standing poles as well as other timbers. Explains the Osmoplastic method of treatment in detail. Write for your copy.

OSMOSE WOOD PRESERVING CO. OF AMERICA, INC. 1437 BAILEY AVE., BUFFALO 12, NEW YORK

THE MASTER OF FLAME
ANSUL
REG. U.S. PAT. OFF.
FIRE EXTINGUISHING EQUIPMENT
DuGas

DRY CHEMICAL FIRE EXTINGUISHERS

WRITE TODAY FOR CHARTS SHOWING COMPARATIVE RATINGS ON FLAMMABLE LIQUID FIRES AS DETERMINED BY NATIONALLY RECOGNIZED APPROVAL AGENCY.

Highest Ratings for Speed and Effectiveness

WITH THE NEW ANSUL-DUGAS DRY CHEMICAL FIRE EXTINGUISHER

Speedy-fast action is the first essential in preventing major fire damage. The NEW Ansul-Dugas Extinguishers, for Class B and C fires have the highest ratings for SPEED and EFFECTIVENESS, pound for pound, as determined by impartial authority. These highest ratings mean positive put-out of your incipient fires by ANY of your employees.

STOP FIRE FASTER!

with Ansul-Dugas Dry Chemical Extinguisher

FEATURES OF THE NEW ANSUL-DUGAS EXTINGUISHER

- Greatly increased fire-killing power.
- Expert extinguishing by inexperienced operators.
- Simplified—faster operation.
- Quicker, easier, on-the-spot recharge after use.
- Greater fire-fighting effectiveness, pound for pound, dollar for dollar.
- Longer range stream and greater shielding of heat from operator.
- Increased fire-fighting capacity without increased weight.
- Engineered to resist corrosion.

ANSUL CHEMICAL COMPANY
FIRE EXTINGUISHER DIVISION, MARINETTE, WISCONSIN

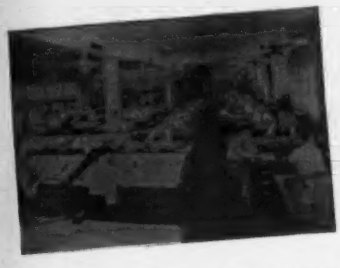
MOLONEY Power

TRANSFORMERS

Moloney Power Transformers have this 5 point assurance of plus performance . . . sound design . . . careful workmanship . . . rigid inspection . . . thorough testing . . . over 50 years experience in the exclusive manufacture of transformers. Moloney Transformers are built to give uninterrupted, trouble-free, on-the-job performance.

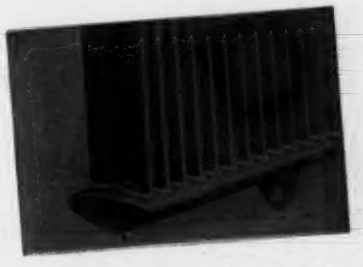
Illustration shown on the opposite page is a Moloney Power Transformer installation: 168,000 Kva of installed capacity, transforming 13,800 to 161,000 volts. This installation is typical of hundreds of Moloney Power Transformer installations throughout the United States and throughout the world.

Check these features ✓✓



Engineering Research, the vital factor in improvement of design, processing and fabrication, has earned for Moloney the title of Pioneer in the Transformer field. It is the reason industry looks to Moloney for new developments in design and efficiency.

Tanks made of high grade steel, electrically welded, with rugged Z-bars or sturdy, welded, box type reinforcement. Bases of heavy channel iron construction prevent distortion of base or tank when handling transformers. Careful pressure testing assures leakproof construction.

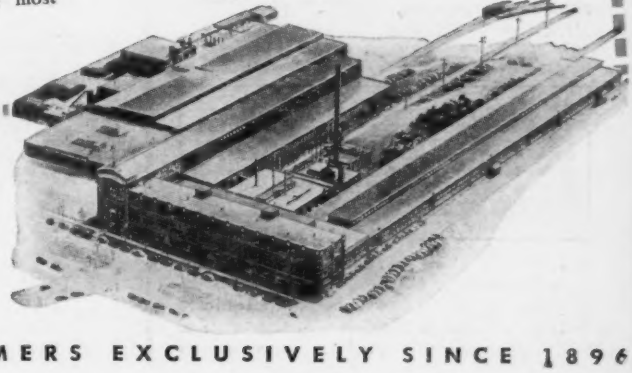


Radiators are of all-welded construction. Tubes are spaced in a double row for easy cleaning and painting. There is no "hard-to-get-at" center row! All welds are external. Headers are designed so that water cannot collect and cause rust.

Where forced air cooling equipment is required on large power transformers, blowers are the centrifugal type. Automatically controlled by oil or hot spot temperature. Driven by weatherproofed motors with self-lubricating ball bearings which require no attention.

Core type construction is standard on all Moloney Power Transformers, thus maximum amount of winding surface is exposed to oil. Circular windings provide greatest possible protection against distortion under the most severe operating conditions.

Preparing to test a power transformer. Besides numerous test boards for standard transformer tests, the Moloney 2,500,000 volt surge generator, with its recording cathode ray oscillograph, is available for impulse testing.



MOLONEY ELECTRIC COMPANY

SAINT LOUIS 20, MISSOURI

POWER AND DISTRIBUTION TRANSFORMERS EXCLUSIVELY SINCE 1896

Cylinder batteries — designed for small capacity, built-in systems. I.C.C. cylinders.
Liquid CO_2 units. Capacities 2000 lbs. to 200,000 lbs. Designed for your large capacity fire systems.
YES — there is something new in Fire Protection Service ... it's MATHIESON
1000-lb. capacity A.S.M.E. containers. Designed for built-in systems using masses of high pressure CO_2.

For the first time in the history of carbon dioxide (CO_2) fire-fighting equipment, one company offers both high and low pressure installations of manual and automatic design. Survey made on request, *THE MATHIESON ALKALI WORKS (INC.) 60 East 42nd Street, New York 17, N. Y.*

Mathieson
CARBON DIOXIDE

Carbonic Gas . . . Dry Ice . . . Caustic Soda . . . Soda Ash Liquid Chlorine . . . Chlorine Dioxide . . . Ammonia, Anhydrous & Aqua . . . HTH Products . . . Fused Alkali Products . . . Synthetic Salt Cake . . . Bicarbonate of Soda . . . Sodium Chlorite Products . . . Sodium Methylate

Mathieson Fire Extinguishing Equipment for every purpose:

- *Existing Plant Facilities*
- *Plant Expansion*
- *New Plants*
- *Special Installations*

netic drive of a vibrating reed. This is said to result in a powerful attraction and repulsion force which assures immediate self starting as well as long period of operation without maintenance.

It is reported to have constant speed characteristics over a wide variation in voltage. Motor may be supplied from battery or line source and on test had a current consumption which varied between 0.06 and 1 watt. Shaft speeds were geared from one revolution each 24 hours to 100 rpm.

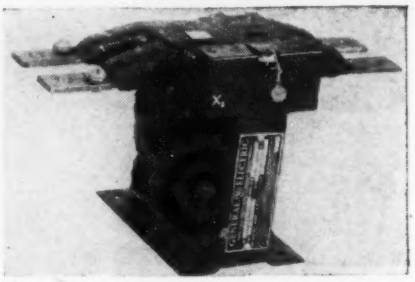
The unit is approved by appropriate governmental agencies for such uses as controlling marine beacons and bouys, aviation signal and obstruction lights, railroad signal devices, time delay controls, automatic delay controls, automatic radio transmissions, and telephone interrupters.

New model is small enough to be held in the palm of the hand and is available for use at 3, 6, 12, 24, 32 or 110 volts.

•

1,200-Volt Indoor C.T. For 3-W Service

A NEW 1,200-volt indoor current transformer designed for metering service on three-wire, single-phase circuits has been announced by the meter and instrument division, General Electric



Co., Schenectady 5, N. Y. Designated Type JL-6, the new transformer is available in primary current ratings 10/ /10 to 400/ /400 amperes, and has been assigned a 30-kv., full-wave rating.

It is of the wound-primary construction and has two primary coils for connection to a three-wire circuit. It has one secondary coil rated at 5 amp. Spacing between primary terminals is 1½ in. for all current ratings, which is to provide for oversize cable lug connection.

•

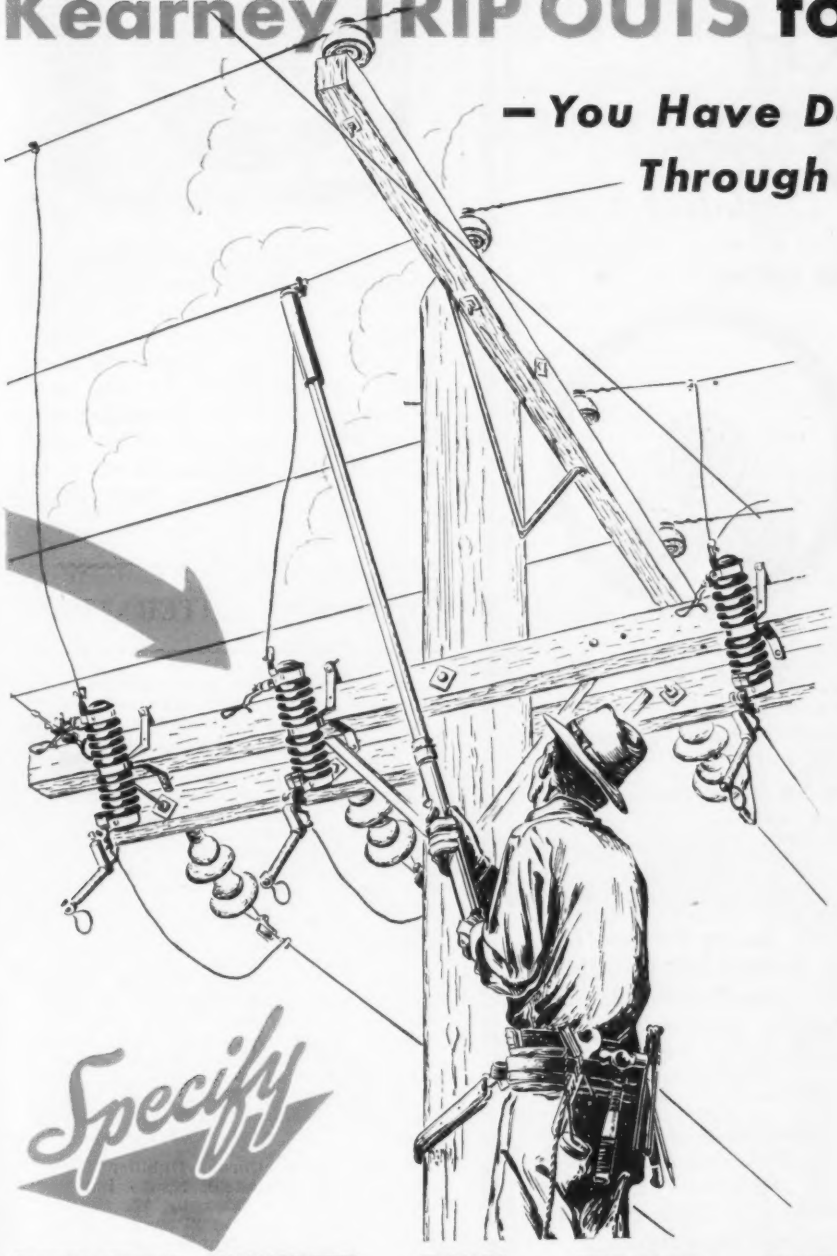
Miniature Selenium Rectifier Has 100 Milliamperes Rating

A NEW MINIATURE five-plate selenium rectifier, type 5M1, designed for application in places where rectifier tubes 25Z5, 35Z5, 117Z6, and OY4 and others in vibrator power supplies and radio re-

When the Lineman Connects

Kearney TRIP OUTS to Your Circuits

— You Have Dependable Protection Through Positive Action



The simplicity of the trip-action assures positive interruption on low overloads as well as heavy short circuits — even during ice and snow.

Built for long dependable service, all current carrying parts are of corrosive resistant materials. Point pressure contacts assure good conductivity and absorb shock effectively.

Re-fusing is quick and easy — convenient lifting hooks permit fast removal and installation.

For the kind of reliable protection that keeps operating costs low, use Kearney Trip Out Switches. Made in ratings 5,000 to 69,000 V., 100 and 200 Amp.

Specify

KEARNEY PRODUCTS

JAMES R. KEARNEY CORPORATION OVERHEAD & UNDERGROUND UTILITY EQUIPMENT

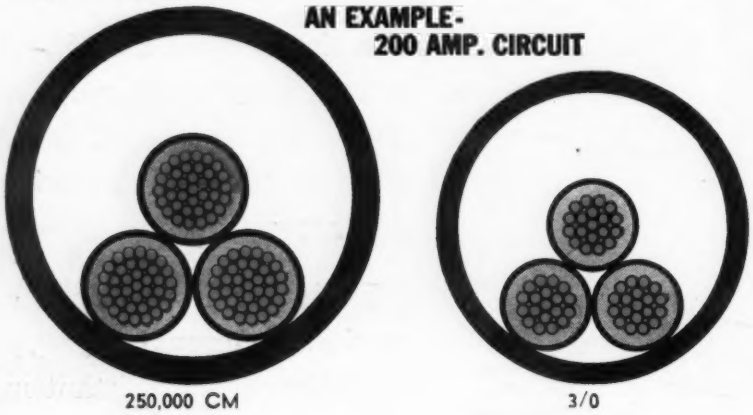
4224-42 CLAYTON AVE., SAINT LOUIS 10, MO. — *Canadian Plant,* LEASIDE, ONTARIO

CRESCENT

ENDURITE Type RH

Gives Greater Current Carrying Capacity per Dollar of Installed Cost

AN EXAMPLE-
200 AMP. CIRCUIT



250,000 CM

3/0

TYPE R

Requires 2½" Conduit. Maximum permissable operating temperature 60°C.

For 100 ft run, cost for wire and conduit — approximately

$159.00

TYPE RH

Requires 2" Conduit. Maximum permissable operating temperature 75°C.

For 100 ft run, cost for wire and conduit — approximately

$116.00

Both figures are based on 330 feet of cable and 100 feet of galvanized steel conduit at PRESENT LIST PRICES. Saving shown—27%.

The superior heat resistant characteristics of CRESCENT ENDURITE INSULATION with its higher permissible operating temperature and therefore greater current carrying capacity, permits the use of a smaller size of conductor, and in most cases smaller size of conduit at less cost than would be required for Type R Wire for the same load.

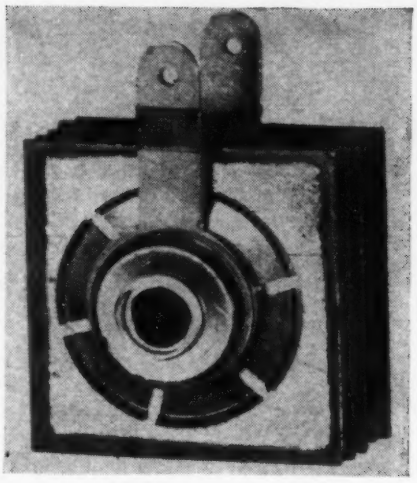
For light loads requiring small sized conductors, Voltage Drop is the determining factor in choice of wire size. Usually in sizes No. 6 AWG and heavier for power circuits or No. 1 AWG and heavier for lighting circuits, CRESCENT ENDURITE Type RH Wire & Cable gives the lowest installed cost-per-ampere of useful circuit capacity.

CRESCENT

WIRE and CABLE

NEMA

CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, NEW JERSEY



ceivers were used, is now being produced by the Radio Receptor Co., 215 West 19th St., New York 11, N. Y. It is 1 x 1 in. in size and is to be used with a 25-ohm series resistor and maximum capacitance of 40 mfd. Maximum continuous current is 100 milliamperes at an ambient temperature of 35 deg. C. Direct current output voltage and maximum alternating current input voltage is 130 volts.

TECHNICAL LITERATURE

Aluminum Alloys—An aluminum alloy selector, a slide-rule type of chart, 8½x11 in. size, containing a mass of technical information concerning 18 of the most widely used aluminum alloys, is available from the Reynolds Metals Co., department 47, 2500 South Third St., Louisville 1, Ky. The chart gives the chemical composition in percentages for twelve elements and shows the physical constants. Also incorporated in the chart is a second slide which shows the tensile strength, yield strength, hardness and elongation for seven different product forms of that alloy.

Carrier Equipment—Problems encountered in the application and use of power line carrier equipment for relaying, telemetering, supervisory control, load control, remote tripping and emergency communication are treated in a Data Book, No. B-3693, published by Westinghouse Electric Corp., Box 868, Pittsburgh 30, Pa. Book is available for a price of $1.00.

Power Factor. Cornell-Dubilier Electric Corp. (South Plainfield, N. J.) has published a 214-page book by W. C. King, sales engineer, entitled "Power Factor in Your Plant." It is unique in that the chapters are addressed to answering an orderly set of questions compiled from those usually asked by industrial engineers when they want to do something about power factor. The announced price is $3.

New Code—"Analysis of 1946 Revision of National Electric Code," publication No. 46-119, compiled by Arthur L. Abbott, is available from the National Electrical Manufacturers Association, 155 East 44th St., New York 17, N. Y., at 50 cents per copy.

Street Lighting—List of national standards for street lighting equipment including transformers, cable, metal standards and wooden poles, is now available from the Street and Traffic Safety Lighting Bureau, 155 East 44th St., New York 17, N. Y.

FARGO MFG. COMPANY, INC. Poughkeepsie, New York

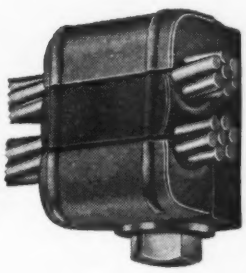
(PRODUCTS DISTRIBUTED By LINE MATERIAL CO., MILWAUKEE, WISCONSIN)

CONNECTORS

"STANDARD" CONNECTORS — 5000 SERIES

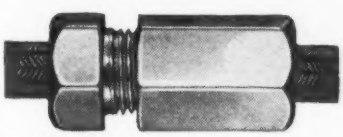
Vise-like design of these solderless connectors produces vibration-proof contact. One-piece construction makes installation easy and fast. The bolt can be removed for convenience in making ground taps, etc., inserted through a hole in a lug, strap, bar, etc., and quickly reassembled. Sizes include #8 to 1000 MCM.

HEAVY-DUTY SPACER-BAR CONNECTORS —7000 SERIES



Designed especially for high current duty. Distortion and "relaxation" at contact area are kept to a minimum. Increased mass helps to dissipate heat due to fault conditions. Spacer bar is of high conductivity electrolytic copper. The 7000 Series has the same vibration-proof, one-piece construction as the standard vise-type connectors. Sizes include #2/0 Str. to 1000 MCM.

CONE TYPE CONNECTORS, SERIES A



The wire gripping cones of these connectors tighten and hold wires to their rated breaking strength when the two components are screwed together. Made of a high copper content alloy. Sizes include #14 Sol. to 500 MCM. Tees and reducing combinations are also available.

RAILROAD SIGNAL BOND

Fargo produces any type of bond for railroad signaling. Flash-Weld Signal Bonds undergo rigid inspection to make sure they are strongly flash-welded at junction of terminal and strand and the terminals are carefully galvanized.

HOT LINE CLAMPS

A.G.E. SERIES

Specifically designed to minimize arcing due to loose contact. Heavy coil load spring takes up on dimensional changes in conductors and maintains high pressure contact constantly. The bolt thread is completely housed and lubricated to prevent corrosion "freezing" of bolt and assure easy turning. Installation can be made with any standard hot stick. Size range includes: Aluminum line wire #6 Sol. to #2 ACSR + Armor Rods; Copper, #6 Sol. to 250 MCM. Tap wire #6 Sol. to #1/0 Str. Clamps available for conductors of aluminum, copper, steel, and copperweld or combinations thereof.

HOT LINE CLAMP SERIES XK

A good general purpose clamp which suits all types of connections, this well-balanced, strong hot line clamp can be used with any type of hot stick. Made of high conductivity copper alloy. Two sizes available to accommodate line wires in ranges from #6 Sol. to #4 ACSR + rods and #6 Sol. to #2 ACSR + rods. Tapwires range from #6 Sol. to #2/0 Str. Copper. Hexagonal head bolts furnished if desired.

ACCESSORIES

TEMPORARY JUMPER CLAMP—Catalog #TJ-1

Offers a fast, convenient and safe means of making temporary jumper contact. Can be installed with one hand. Quarter turn of handle releases spring-action plunger; additional full turn locks clamp. Insulated to withstand 5000 volts, with heavy neoprene covering bonded to metal. The fast spring-action minimizes arcing during installation.

HOT STICK

Holds tight on standard eye bolts of jumper clamps, fuse cutouts, etc., regardless of angle that stick is held. Operated by hand lever on side of head, or slight upward thrust of stick. Automatic lock device prevents accidental release. Knob on hand lever shows position of stick mechanism at all times. Hot Stick is of selected ash with high strength aluminum alloy head.

LINE SPLICES

LINE SPLICE

Fargo Automatic Line Splices hold fast, reduce work hazards, save time. One-piece construction of gripping cones keeps the four jaws of the cones always aligned for automatic adjustment to wire contour. Copper shell provides greater conductivity than an equal length of conductor. Corrosion-inhibiting construction throughout. Standard size range from #8 Str. to 250 MCM. Specials for copperweld and reducers for most combinations are also available.

LOCK NUT TYPE SPLICE

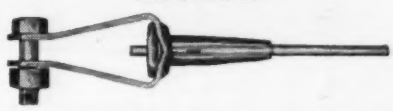
This Automatic Line Splice has the advantages of the standard model above, plus the additional feature of being able to lock the jaws in position. For wire sizes #1/0 Sol. to 250 MCM.

DEAD ENDS

TYPE CL-69

This design includes a standard dead end gripping unit attached to a yoke, permanently hinged on one side to a copperweld bail with pushout fastening on the opposite side. Can be installed easily without risk of loosening parts. Size range same as line splices.

TYPE CL-27



This design is furnished with a standard dead end gripping unit which floats in ball-and-socket joint of galvanized steel clevis. Size same as line splices.

FARGO TWIST SLEEVES

Fargo Twist Sleeves, made of seamless high conductivity copper, are of the proper temper, free from burrs, clearly stamped and conveniently packaged.

ENGINEERING AND DEVELOPMENT SERVICE. Our specialized service offers you complete assistance in developing items for your specific needs. We invite your inquiries on any problems in this and allied electrical fields.

NEWS ABOUT PEOPLE

A. E. Grunert Appointed Chief Operating Engineer

Appointment of Arthur E. Grunert, a veteran of 38 years of service, as chief operating engineer of Commonwealth Edison Co., Chicago, has been announced. He succeeds Paul B. Juhnke, who retired from active duty on January 1, after 43 years of service.

Mr. Grunert started his utility career in 1908 as a draftsman and subsequently became a testing engineer, boiler room engineer, efficiency engineer and superintendent of generating stations. He was promoted to assistant chief operating engineer in 1943. Prominent for many years in committee work of various national engineering associations, Mr. Grunert won the Melville award of the American Society of Mechanical Engineers in 1932 for presenting the best paper of the year at its annual meeting.

A. E. GRUNERT

Mr. Juhnke started in 1903 as an electrician's helper in the construction department. After several promotions he was made chief load dispatcher in 1912, assistant chief operating engineer in 1942 and chief operating engineer the following year. A past chairman of the Chicago section of the American Institute of Electrical Engineers, he is also a fellow and a former director of the organization and was at one time chairman of the electrical section of the Western Society of Engineers. Nearly 270 associates of Mr. Juhnke attended a farewell dinner in his honor at the Union League Club.

P. B. JUHNKE

Also announced by the company was the promotion of Dana D. Higgins to superintendent of generating stations. Mr. Higgins entered the utility's service in 1904.

•

▶ H. H. MARSH, JR., has been appointed general superintendent of substations and shops, Duquesne Light Co., Pittsburgh. Mr. Marsh succeeds R. H. ROUGHEN, who has retired after 42 years with the company. Mr. Marsh has been connected with Duquesne Light since 1922 and in recent years has been assistant general superintendent of substations and shops. Mr. Roughen entered the utility field with the old Allegheny County Light Co. in 1904.

▶ H. L. DELONEY, transmission and distribution engineer of Louisiana Power & Light Co., has been appointed assistant to W. T. Hess, vice-president and chief engineer. Mr. Deloney succeeds R. W. BRASWELL, who has been transferred to Mississippi Power & Light Co. as operating superintendent. Following his graduation from Louisiana Tech in 1931 with a B.S. degree in electrical engineering, Mr. Deloney joined Phoenix Utility Co. and later was transferred to Louisiana Power & Light. In 1935 he was made division electrical engineer and in 1939 was named state meter supervisor and later transmission and distribution engineer.

Truman Appoints Wilson General Manager of AEC

Domestic control and development of America's atomic energy industry was formally transferred from military to civilian direction with the opening of the New Year, keynoted by a pledge to proceed "affirmatively and aggressively with development of peace-time applications" of this force.

The pledge to push peace-time development of atomic power came from the newly appointed general manager of the five-member Atomic Energy Commission, Carroll L. Wilson. The 36-year-old Wilson was named to the key AEC position by President Truman on the eve of transfer to the agency by Presidential executive order of government facilities which cost more than $1,500,000,000 to build and nearly 50,000 research and production personnel from Army's Manhattan District, war-time producer of the atom bomb. As general manager, Mr. Wilson virtually becomes "vice-president in charge of operations" of the commission's activities. His appointment is subject to Senate approval.

C. L. WILSON

During the war Mr. Wilson was executive assistant to Dr. Vannevar Bush in the Office of Scientific Research and Development and last year was secretary of the Lilienthal-State Department Board which developed the basic principles of the U. S. plan for international atomic control.

A graduate, in 1932, from Massachu-

TWELVE KEYS to Steel-Service

Ryerson Steel-Service plants now stand in twelve great cities—key points covering the nation's principal steel markets. Cooperating fully, the twelve-plant Ryerson system means broader facilities, shorter shipping distances, and the assurance of prompt delivery of all products in stock.

The plant near you employs the best of modern handling and cutting methods, from order desk to shipping department. It is planned and operated to meet your steel needs accurately and deliver them in a hurry.

Under present conditions we are often unable to fill all your requirements—much as we would like to. Because of great demand and frequent work stoppages many products may not be in stock when you call. But if your order includes an item not readily available, our steel-service men are well qualified to assist you in the search for a practical alternate. And Ryerson continues as your best source for a wide variety of steels.

Whether you need a single piece of steel or several tons, your order receives thorough, personal attention. So, phone or write or wire your nearest Ryerson plant whenever you need steel.

Joseph T. Ryerson & Son, Inc, Steel Service Plants: New York, Boston, Philadelphia, Detroit, Cincinnati, Cleveland, Pittsburgh, Buffalo, Chicago, Milwaukee, St. Louis, Los Angeles.

PRINCIPAL PRODUCTS

Bars—
hot and cold rolled
alloy steel
reinforcing
Structurals
Plates—
Inland 4-Way Floor Plate
Sheets
Strip Steel
Mechanical Tubing
Boiler Tubes and Fittings
Allegheny Stainless—
Sheets, plates, shapes, bars, tubing, etc.
Tool Steel
Wire, Chain
Bolts, Rivets
Babbitt
Solder
Wire Fabric
Metal Working Tools and Machinery, etc.

RYERSON STEEL

—here's how to SAFEGUARD it!

Apply carbon dioxide with a Kidde Built-in System.

The *Kidde* system feeds a heavy initial discharge of carbon dioxide right into the recirculating ventilating system of a rotating machine—to kill flames.

Additional carbon dioxide during the rundown period maintains an inert atmosphere—prevents glow from rekindling.

Method of operation? Manual or automatic, by means of thermal devices or differential relays.

Easily-installed automatic dampers adapt system to non-recirculating ventilation systems.

Remember . . . carbon dioxide is dry, inert, non-conducting, clean.

Plan this protection now for your new rotating machinery—install it on your present equipment. A Kidde representative will give you full details.

Walter Kidde & Company, Inc., 130 Main Street, Belleville 9, N. J.

The word "Kidde" and the Kidde seal are trademarks of Walter Kidde & Company, Inc.

Kidde

FIRE PROTECTION HEADQUARTERS

setts Institute of Technology with an S.B. degree in engineering and business administration, he served before the war as assistant to Dr. Karl T. Compton, president of M.I.T. and later as assistant to Dr. Bush, then M.I.T. engineering dean, in development of a general program for administration of patents on inventions by Institute staff members. He joined Dr. Bush in 1940 as one of two original members of the National Defense Research Committee, which later became OSRD and which, throughout the war, passed upon the government's vast scientific developmental program that led to, among other things, the atom bomb, proximity fuze, radar development, etc. Since appointment of the Atomic Commission last October, Mr. Wilson has been acting as one of its small consultant staff.

•

Nelson Made Vice-President In Charge of Operations

At meetings of the boards of directors of the two companies in Salisbury, Md., George M. Nelson, manager of operations, was advanced to the position of vice-president in charge of operations of the Eastern Shore Public Service Co. of Maryland and Eastern Shore Public Service Co. of Virginia. In his new capacity, Mr. Nelson will have general charge of all production, transmission and distribution facilities and operations.

G. M. NELSON

Mr. Nelson has been identified with Eastern Shore Public Service since 1926, the company then being known as the Eastern Shore Gas & Electric Co. Following graduation from the University of Delaware, he went to work with the Pennsylvania Railroad and subsequent connections followed with the H. T. Paiste Co. of Philadelphia and with the American Railways Co. He then joined the Philadelphia Electric

PROPOSED CHILDREN'S MEDICAL CENTER, BOSTON, MASS.

CASE FOR A SPECIALIST....

Our broad experience and specialized knowledge in every phase of engineering and construction often are employed during the period of preliminary planning as well as for actual construction of institutional buildings.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

Yes, in a spot like this, quality—BUCKINGHAM quality—means *Everything*. It means quality of design, quality of construction, quality of materials, *experienced workmanship*.

BUCKINGHAM EASY BELT
No. 56-R

That's why the famous STEPHENS CLIMBERS, manufactured exclusively by Buckingham of Binghamton for nearly 50 years, are in such demand by utility companies, telephone companies, and individual linemen. For Stephens Climbers, and *all* Buckingham safety equipment, are made from only the finest materials, under the exacting requirements of safety engineers. They are as safe, as dependable, and as comfortable as it is possible to make them.

A Floating Belt with rolled edges, and padded with sponge rubber. Very light, yet so constructed that it has ample strength for the most severe service. The main part of the belt is 4" wide; the outside strap 1½" wide. The 1¼" tool strap is formed into five loops with a slip-on plier pouch, snap ring and tape carrier. Made from the best harness and chrome tan lace leathers. Floating feature insures full tool loops under all working conditions.

Buckingham

Walter E. Craw, President

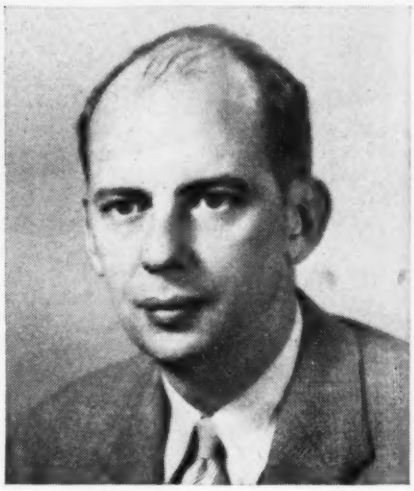
MANUFACTURING CO., INC.
5-7 Travis Street, Binghamton, N. Y.

Co. in the station construction department. With Eastern Shore, he has served successively as right-of-way agent, assistant superintendent of electric operations, superintendent of operations and in 1944 was made operations manager, which position he still holds in the Delaware Power & Light Co., southern division.

•

Westinghouse Lamp Names Slack Research Director

Dr. Charles M. Slack, who developed an electronic tube making possible millionth-of-a-second X-ray exposures, has been appointed director of research for the Westinghouse Lamp Division. Dr.



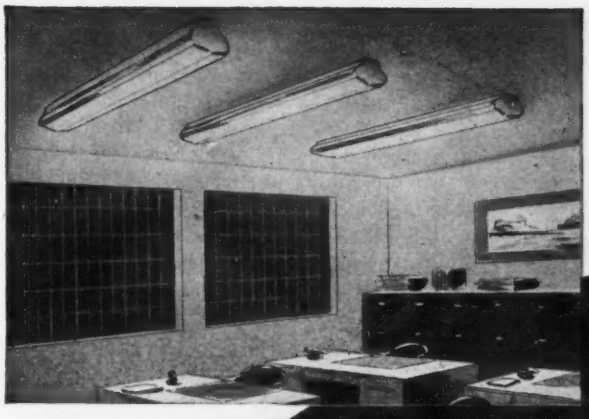
Dr. C. M. Slack

Slack succeeds Dr. Harvey C. Rentschler, director of Westinghouse lamp and electronic tube research for the past 30 years. Dr. Rentschler, who is approaching retirement, will devote himself to completing certain research projects in addition to serving in an advisory and consulting capacity.

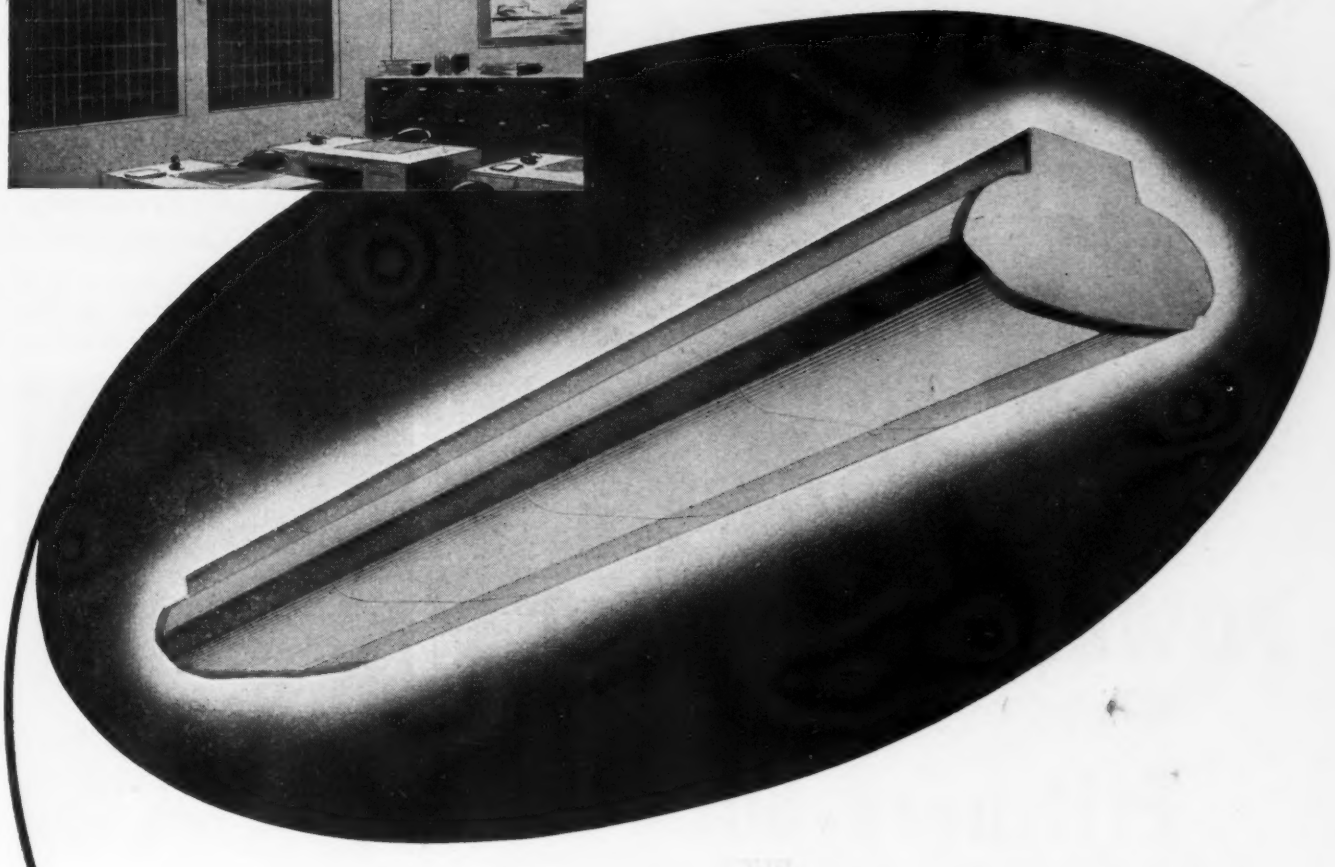
Appointment of Dr. John W. Marden, who has been assistant director of research in charge of the development of rare metals, as manager of a newly-established molybdenum department at the lamp division, has also been announced.

Dr. Slack joined the research department at the Bloomfield plant as a physicist in 1927 and became assistant director of research in 1943. During the war, his super-speed X-ray tube was used in connection with the atomic bomb experiments and for ballistic studies at arsenals and proving grounds in America and Great Britain.

Dr. Rentschler taught physics at the University of Missouri for nine years before joining Westinghouse. He developed the Sterilamp, an ultraviolet lamp which produces bacteria-killing radiations, ten years ago. Dr. Rentsch-



PRODUCT OF HOLOPHANE RESEARCH

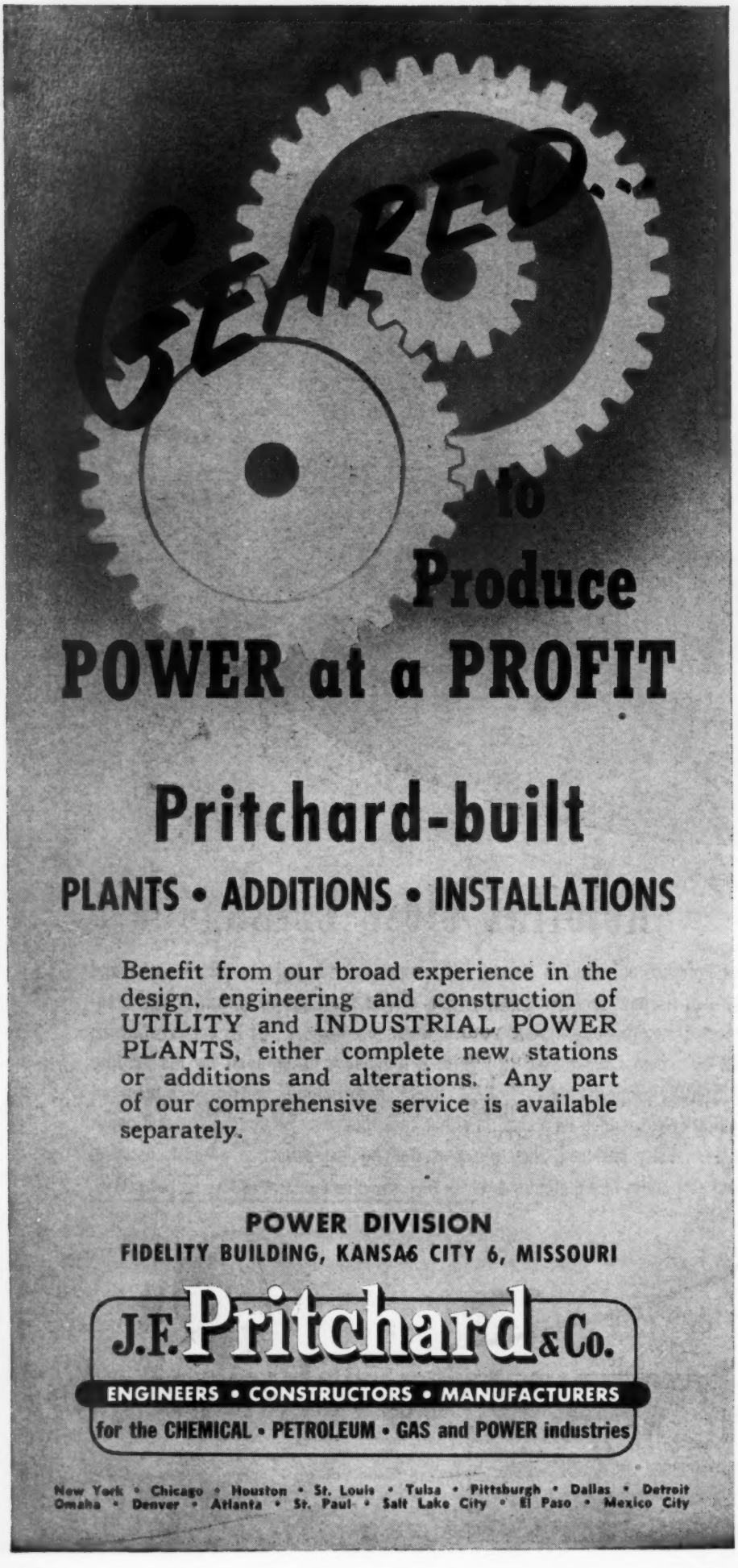


Holoflux Close-Ceiling Unit

Here is a superb new Holoflux unit that is beyond all comparison for lighting effectiveness and architectural beauty . . . Its new curved-type Controlens directs the light downward in an intensive pattern producing maximum illumination with a minimum of glare . . . Its upper refracting sections spread light across the ceiling to furnish a luminous background for the lighting system . . . Gracefully proportioned (only 8 3/8" deep) these Holoflux units may be mounted close-to-ceiling or suspended on stems. In either case they may be ganged for continuous lighting . . . Fully enclosed, they are protected against collection of dust, assuring marked economies in maintenance. **Write for attractive Folder W today; no obligation.**

Holophane
Trade Mark

HOLOPHANE COMPANY, INC.
342 MADISON AVENUE, NEW YORK 17
Holophane Co., Ltd., 385 Yonge St., Toronto, Can.
Lighting Authorities Since 1898


GEARED
to
Produce
POWER at a PROFIT
Pritchard-built
PLANTS • ADDITIONS • INSTALLATIONS
Benefit from our broad experience in the design, engineering and construction of UTILITY and INDUSTRIAL POWER PLANTS, either complete new stations or additions and alterations. Any part of our comprehensive service is available separately.
POWER DIVISION
FIDELITY BUILDING, KANSAS CITY 6, MISSOURI
J.F. Pritchard & Co.
ENGINEERS • CONSTRUCTORS • MANUFACTURERS
for the CHEMICAL • PETROLEUM • GAS and POWER industries
New York • Chicago • Houston • St. Louis • Tulsa • Pittsburgh • Dallas • Detroit
Omaha • Denver • Atlanta • St. Paul • Salt Lake City • El Paso • Mexico City

ler, who has had more than 100 inventions patented, two years ago received the Frank P. Brown Medal, conferred annually by the Franklin Institute for inventions of merit in the building and allied industries.

Dr. Marden developed the 400-watt high intensity mercury vapor lamp and is credited with more than 80 patents, many of them involving metals. He joined the Westinghouse research staff in 1920.

•

Novick Resumes Presidency, Sittig Made Chairman, ECA

Garrard Mountjoy has announced his resignation as president of the Electronic Corp. of America to devote his

S. J. Novick

full time to his work as a consulting engineer to the radio industry.

Samuel J. Novick resumes the presidency of the company which he founded and managed until April, 1946. John J. Sittig, president of the First Colony Corp., has been elected chairman of the board, to succeed Mr. Novick.

Mr. Mountjoy, who first joined ECA as vice-president in charge of engineering, undertook the development of the company's radio products and reconversion from war to peace-time production.

•

▶ Louis G. Pacent, president of the Pacent Engineering Corp., New York, has received the War Department Certificate of Appreciation, awarded in recognition of his engineering services to the Signal Corps. Mr. Pacent is well known in the radio and electrical communication fields. He is a consulting engineer for several companies, and has been actively engaged in the electrical, radio and electronic fields for more than 25 years. He is a fellow of the American Institute of Electrical Engineers

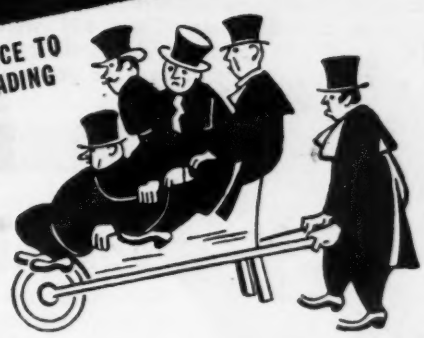
The Swing is to Fiberglas High-Safety-Factor Insulation

RESISTANCE TO EXCESSIVE MOISTURE

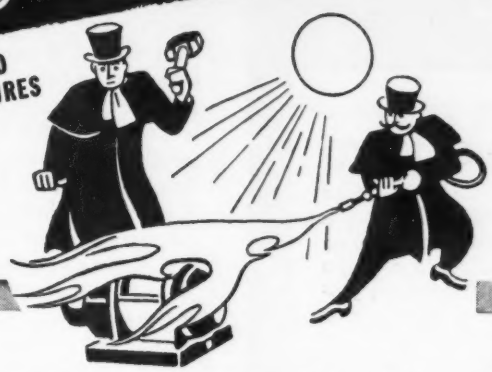
RESISTANCE TO DIRT, DUST AND CORROSIVE ACIDS

Give your products these 5 advantages

RESISTANCE TO OVERLOADING



RESISTANCE TO HIGH TEMPERATURES



You not only get mechanical and electrical advantages by using Fiberglas Electrical Insulation Materials—advantages such as resistance to heat, moisture, oils and acids, and stamina to withstand overload—but you also impart to your product that 5th important element—SALES ADVANTAGE.

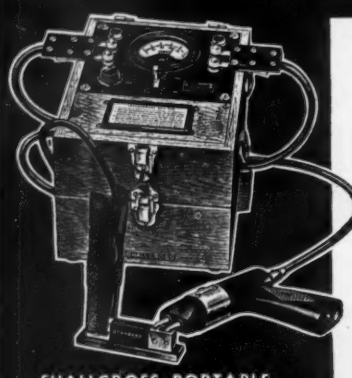
Fiberglas Electrical Insulations have won the preference of thousands of men who design, build and use electrical equipment, by doing a good job on tough assignments throughout industry. Acceptance is growing every day as the unusual combination of characteristics that only Fiberglas can offer becomes known.

Available for almost every electrical insulation need, Fiberglas products have made smaller, lighter and more dependable electrical equipment possible. Have you taken full advantage of Fiberglas in solving your company's production and sales problems? Send for catalog EL 46-11 or the folder "What's a Sales Advantage Worth?" If your distributor does not carry Fiberglas, ask for the name of the Fiberglas supplier located nearest to you. Owens-Corning Fiberglas Corporation, Dept. 858, Toledo 1, Ohio. Branches in principal cities.

In Canada: Fiberglas Canada Ltd., Toronto, Ontario.

OWENS-CORNING
FIBERGLAS

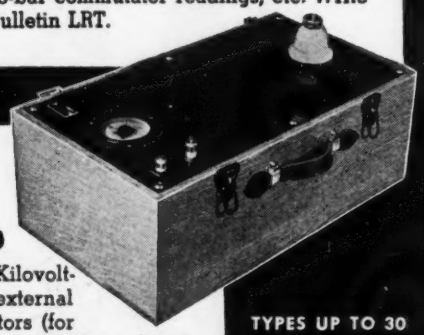
Fiberglas is the trade name for these electrical insulation materials and many other products made from fine, strong, pliable, moisture- and heat-resistant, ageless glass fibers



SHALLCROSS PORTABLE TYPE 645 FOR FIELD INSPECTION WORK

STREAMLINING LOW RESISTANCE MEASUREMENTS

Are you required to make hundreds of accurate "Go, No-Go" low resistance measurements? The Shallcross Portable Low-Resistance Test Sets are ideal for making rapid measurements in bond testing, switch and relay contact resistance testing, bar-to-bar commutator readings, etc. Write for Bulletin LRT.



HIGH-VOLTAGE MEASUREMENT PROBLEMS SOLVED

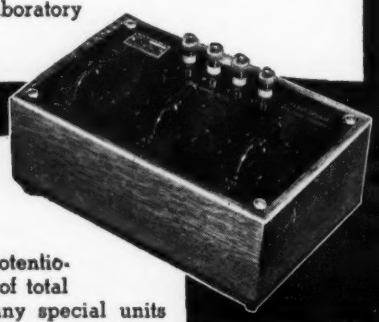
Shallcross Portable Kilovoltmeters, Kilovoltmeter Multipliers (for use with external meters) and Corona Protected Resistors (for voltages up to 200 KV) comprise a complete line of high-voltage measuring apparatus. Over a period of years Shallcross engineers have pioneered in the field of modern high-voltage measurements. They will welcome an opportunity to put their experience to work on your problem.

TYPES UP TO 30 KV AVAILABLE FOR RAPID DELIVERY!

TYPE 638-2 COMBINED KELVIN AND WHEATSTONE BRIDGE

ONE BRIDGE THAT DOES THE WORK OF TWO

Combining both Kelvin and Wheatstone bridges, this popular Shallcross instrument provides a resistance measurement range from 0.0001 to 11.11 megohms in a single portable instrument. Just the thing for maintenance, production line tests, field investigations, school and laboratory work, etc.



TYPE NO. 845 POPULAR 3-DECADE UNIT

ACCURATE VOLTAGE DIVIDERS

Shallcross Voltage Dividers (Decade Potentiometers) are available in a wide range of total resistance and voltage increments. Many special units regularly produced for special applications. Write for latest data bulletins on any Shallcross instrument type.

Shallcross

MANUFACTURING COMPANY

DEPT. EW-27, COLLINGDALE, PA.

ENGINEERING • DESIGNING • MANUFACTURING

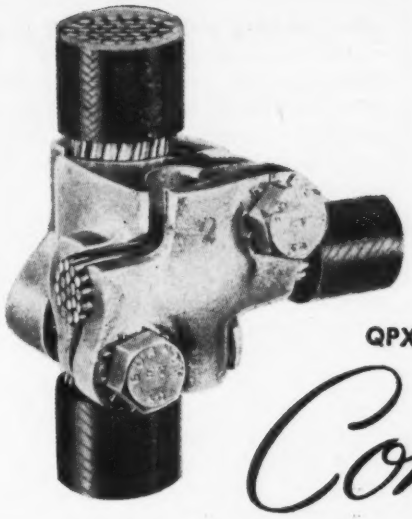
and a member of that society's committee on communication. He is also a fellow of the Institute of Radio Engineers and a member of other technical societies.

▶ E. O. SHREVE, vice-president of General Electric Co. in charge of customer relations, has been appointed chairman of the National Adequate Wiring Bureau's executive committee. Succeeding HERBERT METZ, recently appointed eastern district manager for Graybar Electric Co., who has resigned because of the pressure of other duties, Mr. Shreve assumes his new position on this committee after years of close association with the adequate wiring movement. A former president of NEMA, Mr. Shreve now serves on that association's board of governors and various of the association's committees. He has been an active member of both the NEMA Adequate Wiring Committee and the Bureau's executive committee. Mr. Shreve also holds various important positions with groups and organizations outside the industry.

▶ JOSEPH A. SHERRY has been appointed director of advertising and publicity for the New Jersey Power & Light Co., Dover. For ten years advertising manager of the *Washington (N. J.) Star* and later editor and publisher of the *Hackettstown Courier-Post*, Mr. Sherry has more recently been employed in the public relations department at Picatinny Arsenal. He is succeeding C. FRED WESTIN, who has joined the advertising department of Public Service Electric & Gas Corp., Newark, N. J.

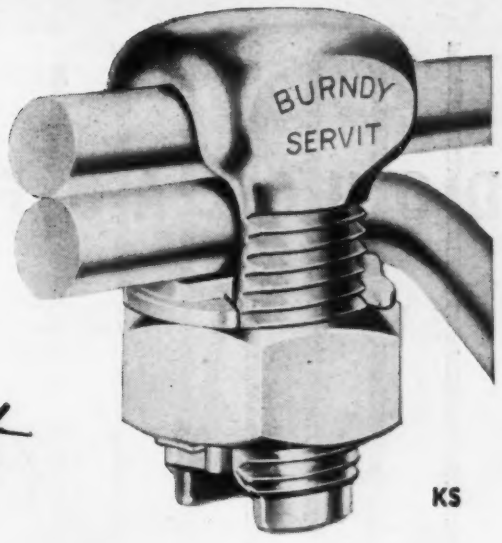
▶ JOHN E. LYNCH, financial vice-president of the Hartford Electric Light Co., and its senior active employee, retired on December 31 after 49 years of service. He entered the company as a clerk, became its secretary in 1909, treasurer in 1924, and attained his present position in 1929. He has been a director of the Connecticut Power Co. since 1921 and was formerly its secretary and treasurer. For some years he also served as secretary-treasurer and a director of the Hartford Electric Steel Corp.

▶ LESTER LEVESCONTE has joined the electrical engineering staff of Sargent & Lundy, Chicago, where he will work on general power system problems. After graduating from the University of Minnesota and the Westinghouse Graduate Training Course, Mr. LeVesconte continued with Westinghouse for ten years in the switchgear engineering, switchgear application engineering and protective relay application section. He then spent seven and one-half years as district central station engineer in the Westinghouse Chicago



QPX

Connect with



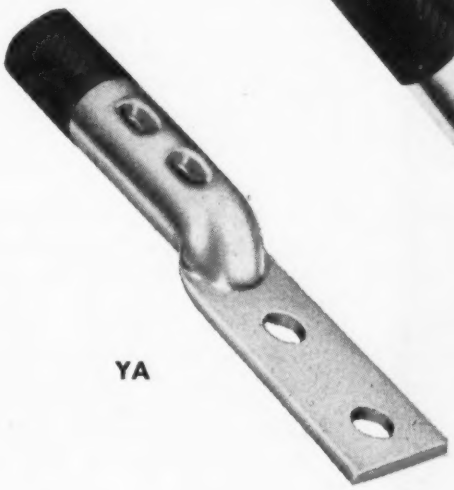
KS

BURNDY

★ Because — you can always depend on the variety of Burndy connectors to provide quick, economical and highly efficient electrical connections.

This dependability stems from Burndy's long leadership in the electrical connector field . . . which has resulted in the acceptance of Burndy connectors for all construction and maintenance requirements. Remember too, deliveries are good at Burndy. Do you have the latest Burndy Catalog?

QT



YA

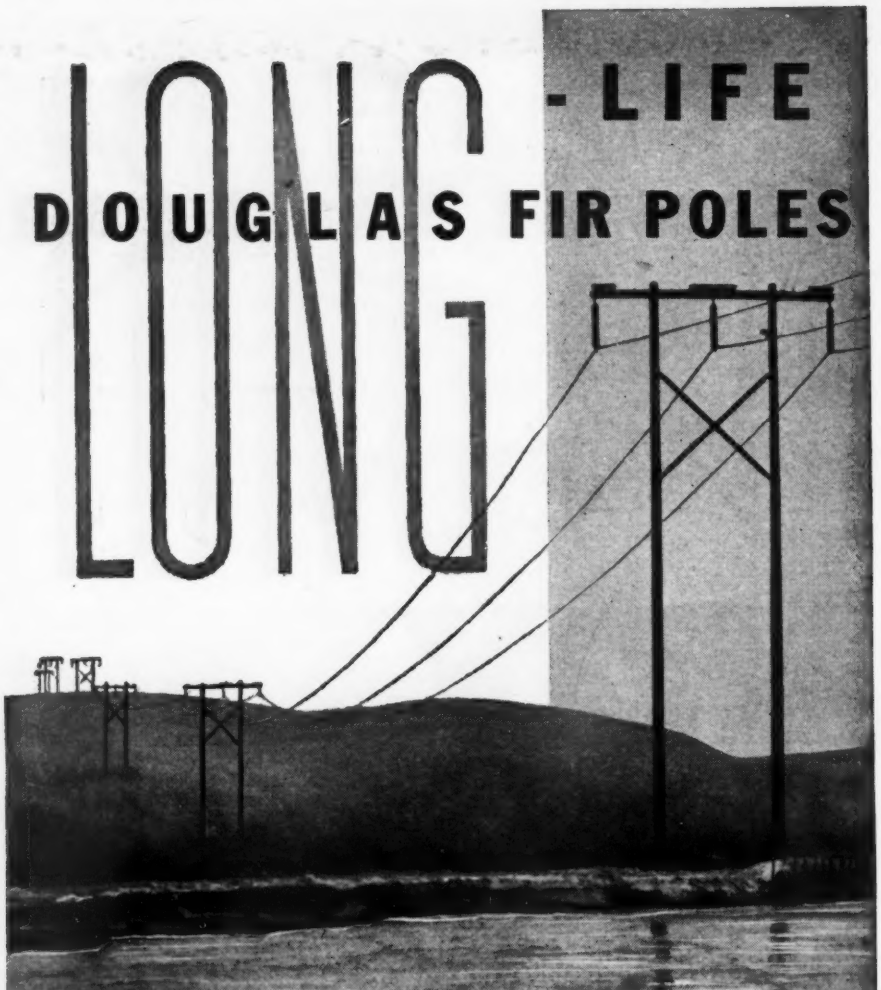
YS

QA

BURNDY · New York 54, N.Y.

IN CANADA: Canadian Line Materials, Limited, Toronto 13
FOREIGN: Philips Export Corporation, New York 17, N. Y.

LONG-LIFE DOUGLAS FIR POLES



Our specialty is long-length Douglas Fir poles, pressure treated for Long-Life service. Prompt shipments of reasonable quantities can now be made in most lengths from 60 foot to 125 foot. Direct rail shipments out of our treating plant stocks can be made to any point in the United States. Write or wire us your inquiries.

Pressure treated Douglas Fir poles have been for years the standard in pole line construction on the West Coast. Our Long-Life Douglas Fir poles meet ASA Specifications and are pressure treated with coal-tar creosote or creosote-pentachlorphenol solution by the empty cell process, 8-lb. retention, in accordance with AWPA Specifications.

Long-Life Douglas Fir poles, pressure treated from high quality Coast-type timber, will cut your maintenance costs and yield longer and more satisfactory service.

Also Produced by J. H. Baxter & Co. of Oregon—an associated company
Plant and Yard—Eugene, Oregon

J. H. Baxter & Co.

333 MONTGOMERY STREET · SAN FRANCISCO 4, CALIFORNIA
LOS ANGELES · LONG BEACH · ALAMEDA · CALIFORNIA, U. S. A.

office, working with all types of power system engineering problems. For the last two years, he has been connected with the Armour Research Foundation, where he supervised the installation and operation of the A.C. network calculator.

▶ EDWARD INGRAHAM, president of the E. Ingraham Co., Bristol, Conn., has been elected president of the Manufacturers Association of Connecticut.

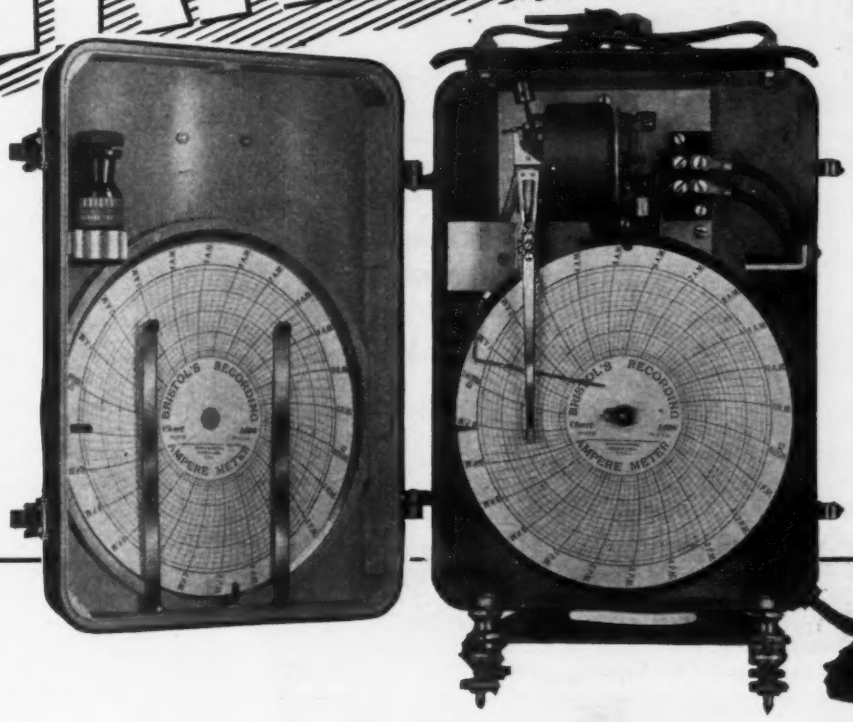
▶ J. A. CORTELLI, formerly chief engineer of commercial engineering, Clark Controller Co., Cleveland, Ohio, has been appointed chief engineer of the company. With the exception of one year, Mr. Cortelli has been connected with the company continuously since 1928. P. M. CHRISTENSEN, formerly research and development engineer, has been appointed manager of the development engineering department. Mr. Christensen joined the Clark company in 1944.

▶ FERDINAND H. RAAB, has been appointed industrial relations manager of the Copperweld Steel Co., Glassport, Pa. Mr. Raab was formerly manager of personnel and industrial relations for the American Aircraft Co., Dayton, Ohio, and later the Standard Dayton Corp., also of that city. Prior to the Dayton assignment, he acquired a broad experience in the field of industrial relations as assistant stabilization director of the Fifth National War Labor Board, management consultant to the Fifth Regional War Production Board at Cleveland, Ohio, and as industrial consultant to the United Nations Rehabilitation Administration at Washington, D. C.

▶ PHILIP BARNES has been appointed advertising manager of the Weston Electrical Instrument Corp., Newark, N. J. He succeeds SIDNEY CASSEY, who has retired after 30 years with the company. Mr. Barnes was a member of the Weston advertising department from 1934 until he went into the Navy in 1943.

▶ J. A. HODGES has been appointed vice-president in charge of sales of the Solar Light Manufacturing Co., Chicago. During the past 20 years, Mr. Hodges has had extensive experience developing lighting sales through utilities, contractors, wholesalers and chain stores. He joined the lamp department of the General Electric Co. in 1926 as a salesman. In 1945 he was called to Nela Park to join the general sales staff and to direct the national sales development of health lamps, particularly germicidal. He resigned from General Electric last September to engage in the manufacture of

WARNING



STOCK ITEM
For immediate shipment

Bristol's Portable Recording Ammeter

Locks securely during travel. Gasketed door. Magnetic damper. Measuring element easily replaceable. One, two or three-pen styles.

YOU'LL STAY A STEP AHEAD OF TROUBLE WHEN YOU USE THIS INSTRUMENT TO RECORD CURRENT FLUCTUATIONS

Bristol's Portable Recording Ammeter will go trouble-shooting with you wherever you go.

Hang it on a pole . . . mount it on a wall . . . take it down a manhole . . . set it on a damp cellar floor . . . it responds instantly and accurately to the slightest fluctuation in current.

Lightweight (17 lbs.), compact, sturdy, Bristol's Portable Ammeter combines convenience with accuracy to give you a constantly reliable picture of what's going on.

Write for complete facts in Bulletin E1100. Address THE BRISTOL COMPANY, 116 Bristol Road, Waterbury 91, Conn. (The Bristol Company of Canada, Ltd., Toronto, Ontario. Bristol's Instrument Company, Ltd., London, N.W. 10, England). Makers of Metameter, Recording Ammeters and Voltmeters, Thermoverter and a broad line of automatic controlling and recording instruments.

Gives You the Facts when and where you want them

AUTOMATIC CONTROLLING AND RECORDING INSTRUMENTS

In these days of rising labor costs, savings are important somewhere along the line. And that's just where BLACKBURN Service Entrance Connectors work for maximum efficiency and economy. Their circular construction gives extra strength along the line of pull of the screw. What's more, BLACKBURNS are the *only* connectors made of DURONZE, which is over 50% stronger than hard copper or commercial bronze, commonly used in the industry. They will not stretch or distort—will not come loose. They're a QUALITY product—It pays to use them!

BLACKBURN Service Entrance CONNECTORS

★

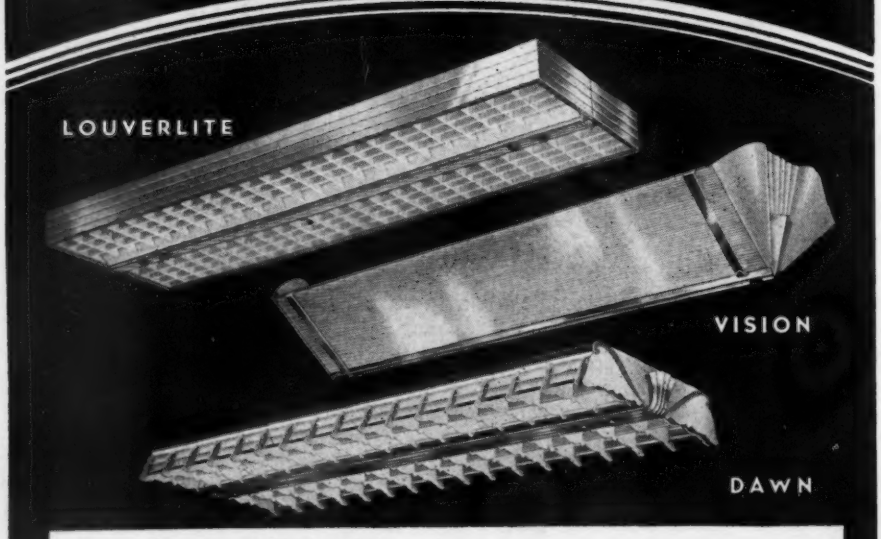
OVER 100 CONVENIENTLY-LOCATED JOBBERS' STOCKS

BUILDERS OF QUALITY CONNECTORS FOR OVER 10 YEARS

JASPER BLACKBURN PRODUCTS CORP.

FIRST, MADISON & CLINTON STS. • ST. LOUIS 6, MISSOURI

Smithcraft . . . THE FLUORESCENT with *custom-made* quality and appearance



A Complete Line of Industrial and Commercial Fluorescents

Distributed exclusively through electrical wholesalers

Smithcraft LIGHTING DIVISION Chelsea 50, Mass.

both lighting and germicidal fixtures. BERNARD LAZERSON has been made chief engineer of Solar Light. Mr. Lazerson has been identified with the company since 1933 and during this period has had extensive experience in lighting fixture design and manufacture as well as installation design and field selling. He will continue as secretary of the company in addition to his duties under the new appointment.

OBITUARY

Frank H. McCullough

Frank H. McCullough, vice-president of the Kansas Gas & Electric Co., Wichita, Kan., died on December 21 following a cerebral hemorrhage suffered at his home. He was 49 years old.

Mr. McCullough's business career was entirely with the utility industry and he was a pioneer in utility merchandising and load building. A native of Wichita, he joined the Kansas Gas & Electric Co. in 1920 in the sales department. After working in various positions in that department, he was promoted to general sales manager in 1926. He was appointed Wichita division manager in 1940 and two years later was elected vice-president.

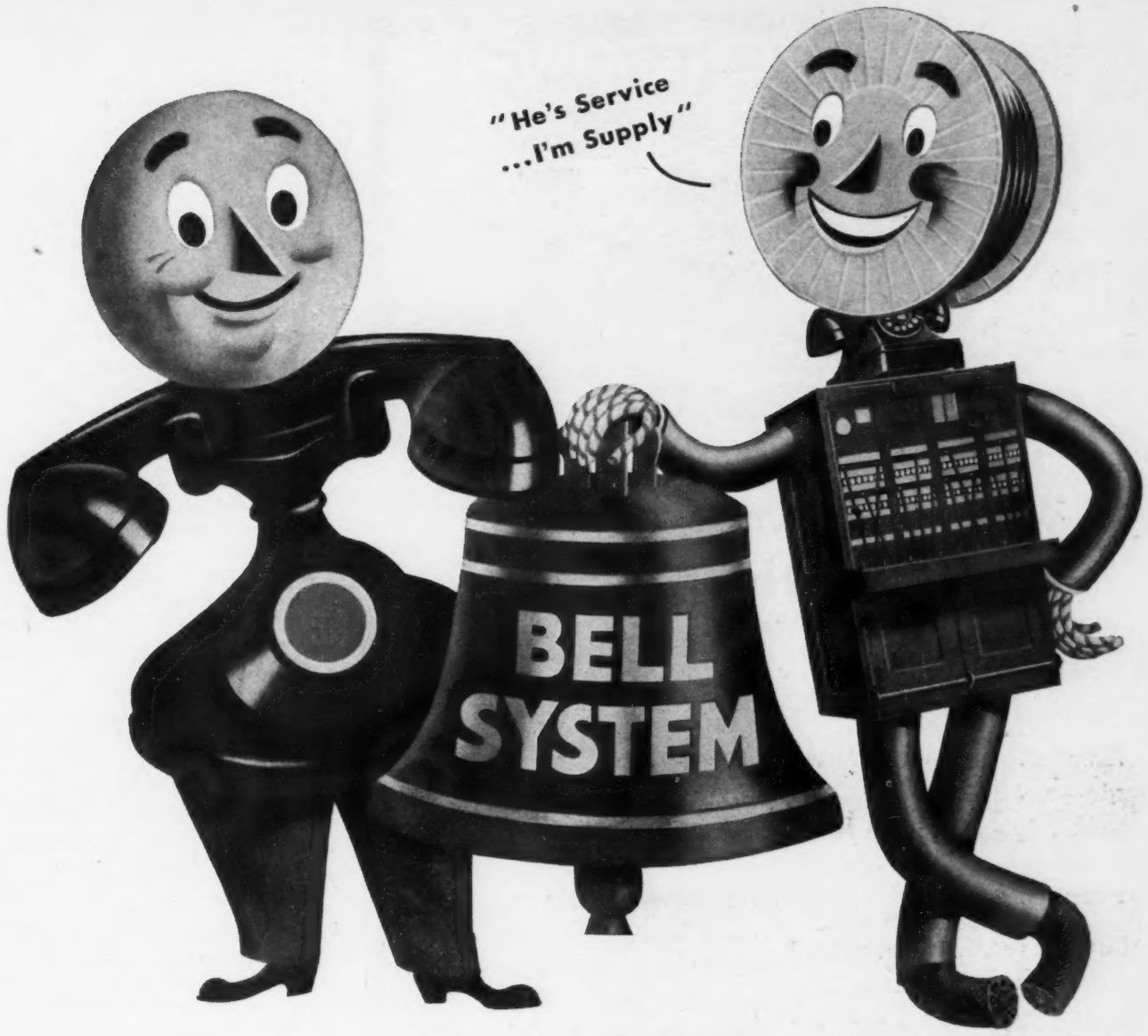
On special assignment in 1925 for the Electric Bond & Share interests, Mr. McCullough arranged and trained the first sales department for the Cia Cubana de Electricidad, Inc., at Cien Fuegos, Cuba. He had served as a committee member of the Edison Electric Institute, Commercial Section, and as both member and chairman of the sales committee of the Missouri Valley Electric Association.

•

▶ LEWIS L. BRASTOW, formerly sales manager for the Trumbull Electric Manufacturing Co., Plainville, Conn., died on January 9 at his home in that city at the age of 72. Mr. Brastow was sales manager of the company for 25 years until 1936, afterward limiting his activities to sales promotion work.

▶ FRANK H. SWAYZE, president of the Whitney Blake Co., New Haven, Conn., died on January 4 in Phoenix, Ariz., at the age of 68. Mr. Swayze was a former president of the New Haven section of the National Metal Trades Association and also of the New Haven Manufacturers Association.

▶ MALCOLM HUBBARD, vice-president of the Brazilian Traction, Light & Power Co., Limited, died at his home in Cobham, England, on December 22. Mr. Hubbard was also vice-president of



"Teamed-up for you since '82"

"WE'RE symbols of a unique industrial team that has been working for you for 65 years. With our research teammate — Bell Telephone Laboratories — we've helped to give you the world's best telephone service at the lowest possible cost.

"My part of the job is to supply high quality products that meet exacting standards.

"I *manufacture* telephone equipment... *purchase* all manner of supplies for Bell Telephone Companies... *distribute* equipment and supplies to them from stocks maintained at my factories and my 29 warehouses ... *install* central office equipment.

"Right now, I'm providing more telephone equipment and supplies than ever before. Using all my knowledge and skill, gained through years of experience, I'm going at top speed to catch up with the greatest demand on record.

"Remember my name... it's Western Electric."

MANUFACTURER... of 43,000 varieties of telephone apparatus.

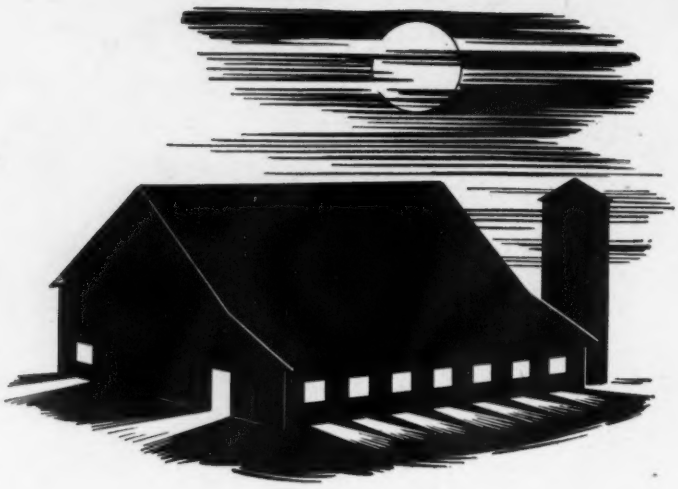
PURCHASER... of supplies of all kinds for telephone companies.

DISTRIBUTOR... of telephone apparatus and supplies.

INSTALLER... of telephone central office equipment.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882



Just three years from the Derby...

A spider-legged red colt in the stable was bred to be a winner.

It was a hard birth. Help was needed—and that help might well have been impossible in darkness or with only the flickering light of a smoky lantern.

But the veterinary was aided by brilliant electric lighting. The little fellow took his first uncertain step at midnight—in a stable bright as day. He'd fulfill his destiny.

●

Power for lighting this farm is carried on lines using Owens-Illinois Power Insulators. These insulators for rural lines and other medium voltage requirements are made by a pioneer company in the glass insulator field. Every care is taken in manufacturing, testing and inspection to insure dependability and uniform quality.

●

Owens-Illinois Insulator No. 514 has been approved by the Technical Standards Committee of the Rural Electrification Administration under the limits of AIEE Specifications No. 41-1944. Designed for 15,000 volt lines.

Principal jobbers carry stocks of this and other Owens-Illinois Power Insulators. Orders are being promptly filled.

OWENS-ILLINOIS POWER INSULATORS

Owens-Illinois Glass Company, Hemingray Division, Muncie, Indiana

Mexican Light & Power Co., Limited, and until recently was chairman of the board of Barcelona Traction, Light & Power Co., Limited.

▶ FRANK C. STOCKWELL, Anson Wood Burchard professor of electrical engineering and chairman of the department of electrical engineering at Stevens Institute of Technology, Hoboken, N. J., died suddenly at his home in that city on December 29 at the age of 63. Professor Stockwell joined the faculty of Stevens Institute in 1907. From 1913-1925 he was also chief instructor in laboratory practices courses at the New York Edison Co., now the Consolidated Edison Co., and educational director, 1925-1932. He was in general practice as consulting electrical engineer; expert in legal actions and patent litigations, and consulting engineer for the Empire Electric Brake Co., Newark, N. J. Professor Stockwell was a member of the American Institute of Electrical Engineers, the Institute of Radio Engineers and the American Society for Engineering Education.

▶ GEORGE J. RICK, New England manager for the Faraday Electric Corp., Brookline, Mass., died on January 2 at the age of 57. Previous to his Faraday connection, Mr. Rick held the position of signal sales manager of the Holtzer Cabot Electric Co., Boston, for 25 years.

▶ THOMAS WALLACE, who at one time operated the Ansonia Electrical Co., Ansonia, Conn., died at his home in New Haven on January 7 at the age of 86. Mr. Wallace had retired from active business. Ansonia Electrical was purchased in 1942 by the Noma Electric Co.

▶ JARED A. HILL, head of air-conditioning, wiring and National Electrical Code responsibilities for Pacific Gas & Electric Co., died in San Francisco December 12 after a long illness. Born and educated in New York State, Mr. Hill went west following a job with Solvay making TNT in World War I. He worked for Hunter Hudson, consulting engineers, then joined P.G.&E.'s sales division. He had been chairman of the wiring committee of Pacific Coast Electrical Association, member of the executive committee of Southwestern Section, International Association of Electrical Inspectors, and last year he was named to serve as an alternate on the Electrical Committee setting up the national code.

▶ ALBERT H. BECKWITH, district superintendent for the Washington Water Power Co., died November 2 at Spokane, Wash.

HERE'S REAL CONTACT EFFICIENCY!

SILVER-GRAPHITE

30% HARDER FOR LONGER LIFE . . .
GREATLY IMPROVED CONTACT DROP

This new Stackpole material is 30% harder than conventional Silver-Graphite contact types. It greatly prolongs contact life under short circuit conditions, assures far better contact drop, and tremendously improves wearing qualities. It contains from 3½% to 10% graphite and can be made in practically any needed contact shape or size for a wide variety of circuit breaker, contactor and relay applications. On particularly difficult high-amperage applications the use of one of these contacts operating against an FW-41 silver-tungsten contact may provide truly outstanding efficiency.

SILVER-TUNGSTEN

STACKPOLE FW-41 FORMULA
HANDLES HIGH AMPERAGES

Through the efficiency of this Stackpole silver-tungsten contact material, the interrupting capacity of a circuit breaker made by a leading manufacturer was increased from 10,000 to 15,000 amperes. On special test, it interrupted 21,000 amperes without apparent harm to the contacts! Not only that, but Stackpole's FW-41 contact formula paved the way to constructing this same circuit breaker to a size one-third smaller by volume and with half as many parts! Write for details.

NOTE: Stackpole Contacts are sold only for original equipment purposes—not as replacements.

Write for Stackpole Contact Catalog and Data Book No. 12

STACKPOLE CARBON COMPANY, ST. MARYS, PA.

STACKPOLE

BRUSHES AND CONTACTS (All molded carbon, graphite, and metal composition types) • RARE METAL CONTACTS • SINTERED ALNICO II • WELDING CARBONS • MOLDED IRON CORES • PACKING, PISTON and SEAL RINGS • CHEMICAL CARBONS, etc.

MANUFACTURERS & MARKETS

Exposition Will Feature Many New, Improved Products; Heavy Attendance Expected

More than 60 prominent electrical manufacturers will show, demonstrate and explain features of their latest and improved designs to the thousands of engineers expected to attend the Electrical Engineering Exposition in the 71st Regiment Armory. Advance information indicates a full range of transmission and distribution equipment as well as testing and indicating instruments will be on display for an anticipated heavy attendance.

Includes Prominent Companies

Among the prominent companies displaying equipment will be the Aro Electric Co. who will show closed and open types of snap-action switches of single and multi-pole designs. The American Bridge booth will feature transmission towers; the American Steel & Wire, wire and cable, fences and wire enclosures. Albert & J. M. Anderson will show a complete line of battery charging and general purpose plugs and receptacles, heavy duty knife switches, welding tools, time switches, insulators, and power distribution devices. Electrical distribution fittings for substation, high tension and distribution line usage will be shown by Anderson Brass Works.

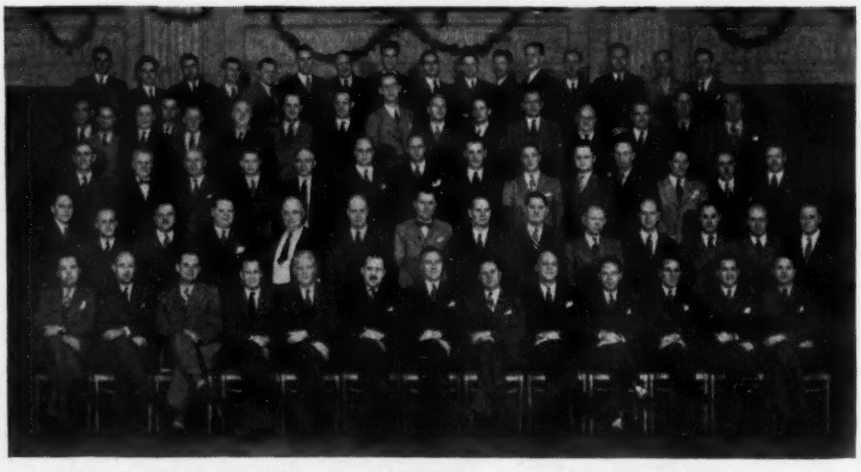
"Megger" insulation and ground resistance testers will be featured by James G. Biddle Co. Lineman's safety equipment including climbers, body belts, safety straps, climber straps, pouches, pads, etc., will be on display by Buckingham Mfg. Co. Electrical connectors for substations, overhead transmission and distribution lines, underground systems, and for industrial wiring and grounding will be the central theme of the Burndy exhibit.

Other prominent companies exhibiting and the products shown include: Capacitron Co., oil-filled condensers and power factor connection condensers; Clare & Co., custom built relays for electrical, electronic and industrial uses; T. J. Cope, Inc., tools and equipment for the installation and maintenance of cable; John C. Dolph Co., electrical insulating varnishes and compounds; Dossert Mfg. Co., connectors for all types of service; Dow Corning Corp., silicone insulated motors, transformers and components; Allen B. Du Mont Laboratories, Inc., high frequency equipment including heating and testing apparatus, controls and telemetering systems; Electric Arc, Inc., stress-relieving apparatus, welding machinery and induction heating apparatus.

Electric Power Equipment Corp., new outdoor disconnect switches; Electro Switch Corp., rotary snap switches; Electro-Tech Equipment Co., new pyrometer designs and electrical testing instruments and controls; Elliott Co., eight-pole, drip-proof sleeve bearing squirrel cage induction motor; Federal Electric Products Co., motor controls, push button stations, multibreakers, safety switches, service equipment, bus duct, and motor controls; Four Wheel Drive Auto Co., a 1947 model line construction and maintenance truck; Gulow Corp., variable volt and power transformers.

Heinemann Electric Co., service equipment, circuit breakers and load centers, including a new method of using circuit breakers in service entrance equipment; Hubbard & Co., lightning arresters, fuse cutouts and pole-line hardware; Industrial Timer Corp., synchronous motor-driven timing devices; International Resistance Co., resistors; Malleable Iron Fittings Co., full line of pole line hardware; Martindale Electric Co., motor maintenance equipment, testing instruments, and safety devices; O. F. Masin, motor driven timers, oil-filled condensers, counters, snap action switches, relays, thermostats, contactors, and terminal blocks; Metron Instrument Co., electric tachometers; Metropolitan Devices Corp., complete line of switch and metering devices; National Varnish Products Corp., electrical insulations; O. Z. Electrical Mfg. Co., cable terminators, conduit fittings, connectors, and grounding devices.

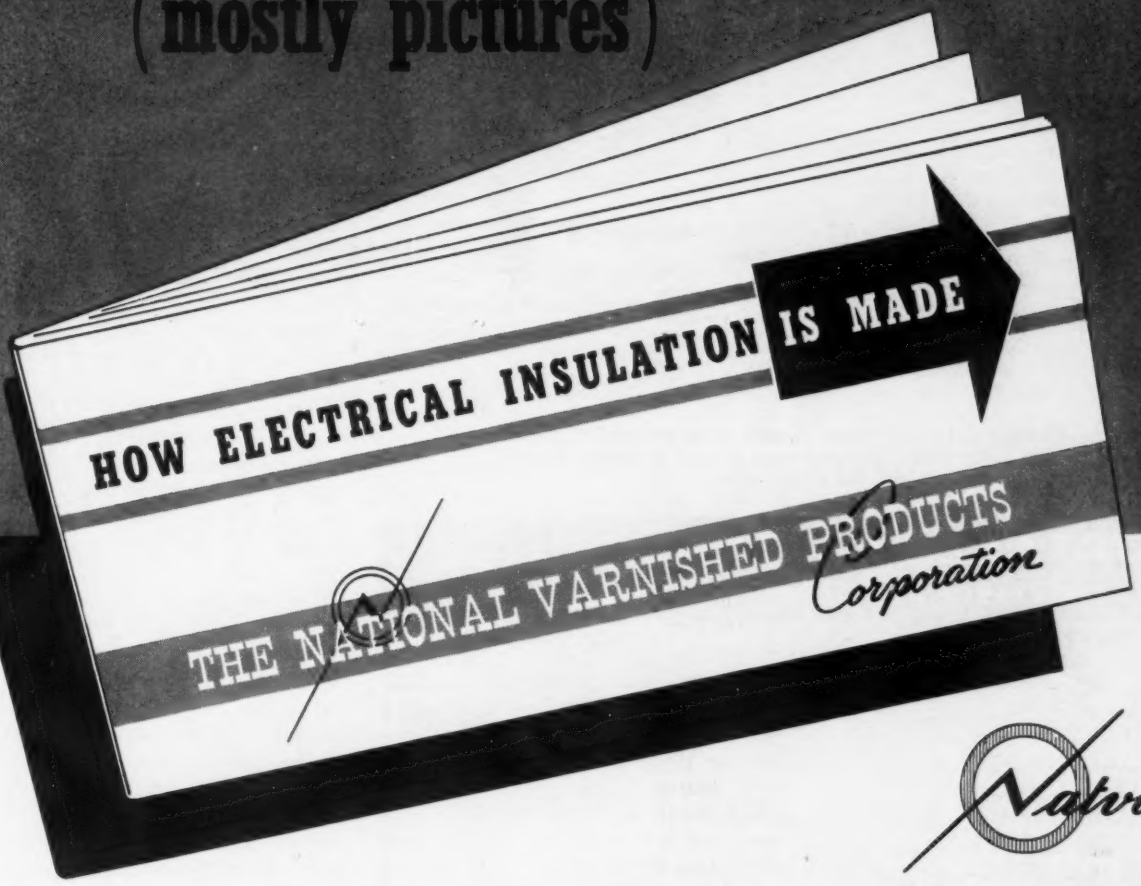
Osmose Wood Preserving Co., technique of preserving poles at the ground line; Owens-Corning Fiberglas Corp., Fiberglas insulation; Production Instrument Co., mechanical, electrical and predetermined counters; Rowan Controller Co., motor control and starting equipment, push buttons, safety, float, drum and lighting switches;



FOR CUSTOMER'S BENEFIT—Field engineers of Line Material's three eastern divisions and the Canadian Line Materials Ltd. met with company officials in Philadelphia to discuss the new items added to the line, improvements in the standard lines of products, and methods of further improving service to customers. This was the first of three such four-day regional engineering conferences. The others will be held in Kansas City and San Francisco

A New Booklet . . .

(mostly pictures)



Natvar

This new booklet will take you on a quick trip through the Natvar plant, and show you the principal steps in the manufacture of the electrical insulation you use every day. We think you will find it interesting.

If you expect to attend the Electrical Engineering Exposition, we will have your copy waiting for you at Booth #114. If you find that you can't make it, we'll be glad to mail you your copy.

Natvar Products

- Varnished cambric—straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished silk
- Varnished special rayon
- Varnished Fiberglas cloth
- Silicone coated Fiberglas
- Varnished papers
- Varnished tubings and sleevings
- Varnished identification markers
- Lacquered tubings and sleevings
- Extruded Vinylite tubing
- Extruded Vinylite identification markers

Ask for Catalog No. 20

THE NATIONAL VARNISHED PRODUCTS Corporation

TELEPHONE
RAHWAY 7-2171

CABLE ADDRESS
NATVAR: RAHWAY, N. J.

221 RANDOLPH AVENUE ★ WOODBRIDGE NEW JERSEY

A NEW Strauss LINEMEN'S BELT

Web for **STRENGTH**
Leather Lining for **COMFORT**

A new Strauss Linemen's safety belt, constructed of great "known strength" web and lined with smooth, comfortable leather is now being manufactured by the Safety Division of Portable Products Corporation. This new Strauss belt retains all of the outstanding qualities of diamond-stripe web while presenting the user with the additional comfort and convenience of having leather against his body.

Additional Features

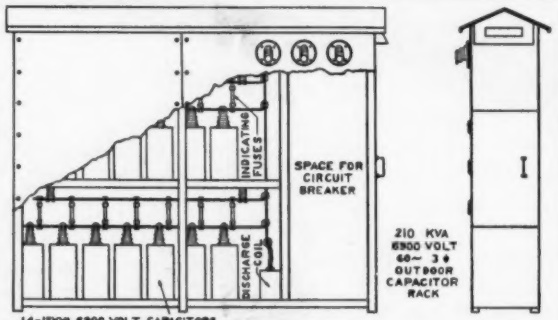
- Oak tanned harness leather loop straps, riveted to floating web belt.
- Drop-forged special steel hardware attachments.
- Fully equipped with plier pocket, tape holder and "snap."
- All stitching done on a hot wax machine.
- Weight only three pounds—available in any size.

The Portable Safety Division manufactures a complete line of Strauss safety belts, hats, and caps for use in almost every type of industry. Write for full details.

PORTABLE SAFETY *Division*
PORTABLE PRODUCTS CORPORATION
395 BLVD. OF THE ALLIES PITTSBURGH 19, PA.

FAST

HORIZONTAL OR VERTICAL INDOOR OR OUTDOOR RACKS AND CAPACITORS FOR POWER FACTOR CORRECTION


INDICATING FUSES
SPACE FOR CIRCUIT BREAKER
DISCHARGE COIL
14-150KVA 6900 VOLT CAPACITORS
210 KVA 6900 VOLT 60~ 3 ϕ OUTDOOR CAPACITOR RACK

We are prepared to supply Racks and Rack Units to meet the demands of Utilities and Industrials for raising power factor. They will pay for themselves in 2 to 5 years. May we suggest you let us figure on your 1947 requirements.

Racks (Indoor or Outdoor) and Capacitors can be designed to cover ratings from 22½ to 315 KVA in voltages from 230 to 7200. They may be "Y" connected for higher voltage applications. (2 or more racks may be joined to give any desired correction.)

Low voltage units are internally fused and are supplied with internal discharge resistors.

High voltage units are not fused inside but can be supplied with or without discharge resistors. For large installations a separate discharge coil is provided for each bank.

Fast Power Factor Correction Units are checked for a minimum of 5000 Megohms - Microfarads insulation resistance and a maximum power factor of 0.4%. All units are tested at twice rated A.C. voltage between terminals and twice rated voltage plus 1000 VAC to the container. High voltage units are given an additional D.C. test equal to three times peak voltage.

Send for FAST Catalog No. 20. Gives helpful information and data on Industrial Capacitors. Includes convenient Calculation Graph.

JOHN E. FAST & CO.
CAPACITOR SPECIALISTS For Over a Quarter Century
3121 NORTH CRAWFORD AVENUE, CHICAGO 41
Canadian Representatives: Beaupre Engineering Works Reg'd. 3935 Newmarch Street, Montreal, for Power Factor Correction

"When You Think of Capacitors . . . Think FAST"

Schweitzer & Conrad, Inc., fuses, fuse links, cutouts and load interrupter switches; Sigma Instruments, Inc., relays; Southern States Equipment Corp., fuses and switchgear; Sprague Electric Co., capacitors of all types, resisters and filters.

Standard Transformer Co., distribution, power, metering, testing and street lighting transformers utilizing oil, air and Askarel for cooling; Star Expansion Bolt Co., expansion shields for lag screws, toggle bolts, etc., and masonry drills; Stricht Co., Inc., tachometers, "Megohmeters", rheostats, recorders, and electronic control apparatus; Swivelier Co., adjustable portable lighting fixtures; Tobe Deutschmann Corp., transmission line testing equipment; Trumbull Electric Mfg. Co., "packaged" switchboards, enclosed bus bar secondary distribution system, enclosed infra-red radiant heating industrial oven, and circuit breakers; Van Wagner Co., inspection mirror lights; Waterman Products Co., Inc., oscilloscopes and wattmeters; Weston Electrical Instrument Corp., electrical and temperature measuring instruments; Winslow Co., electrical testing instruments for laboratory and industrial uses; and the Wiremold Co., surface raceway systems lighting equipment.

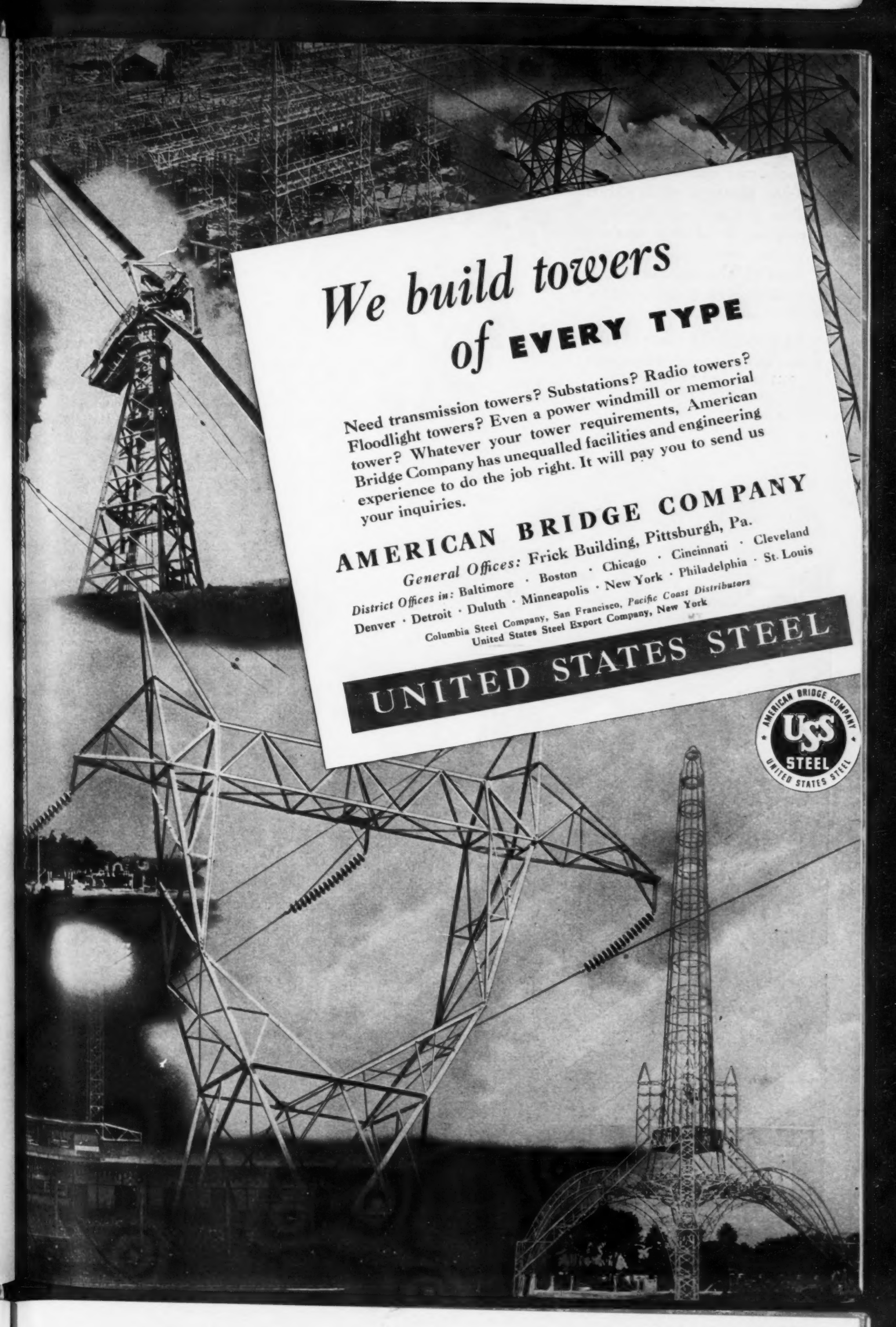
Support for the Exposition developed very rapidly, Charles F. Roth, president, International Exposition Co., who are supervising the show, and E. K. Stevens, manager of the exposition had previously made known (Electrical World, September 14, page 168 and December 28, page 16). Many of the manufacturers in their displays are including plans for demonstrations of the products either being manufactured, tested or used.

•

New Unit Formed to Take Over Discontinued Lines

Finding it impracticable to continue production of Type "P" rotary snap switches and Type JR multipole rotary switches, the Ark-Les Switch Corp., Watertown, Mass., has announced the formation of the Electro Switch Corp. of Weymouth, Mass., to take over this part of the business.

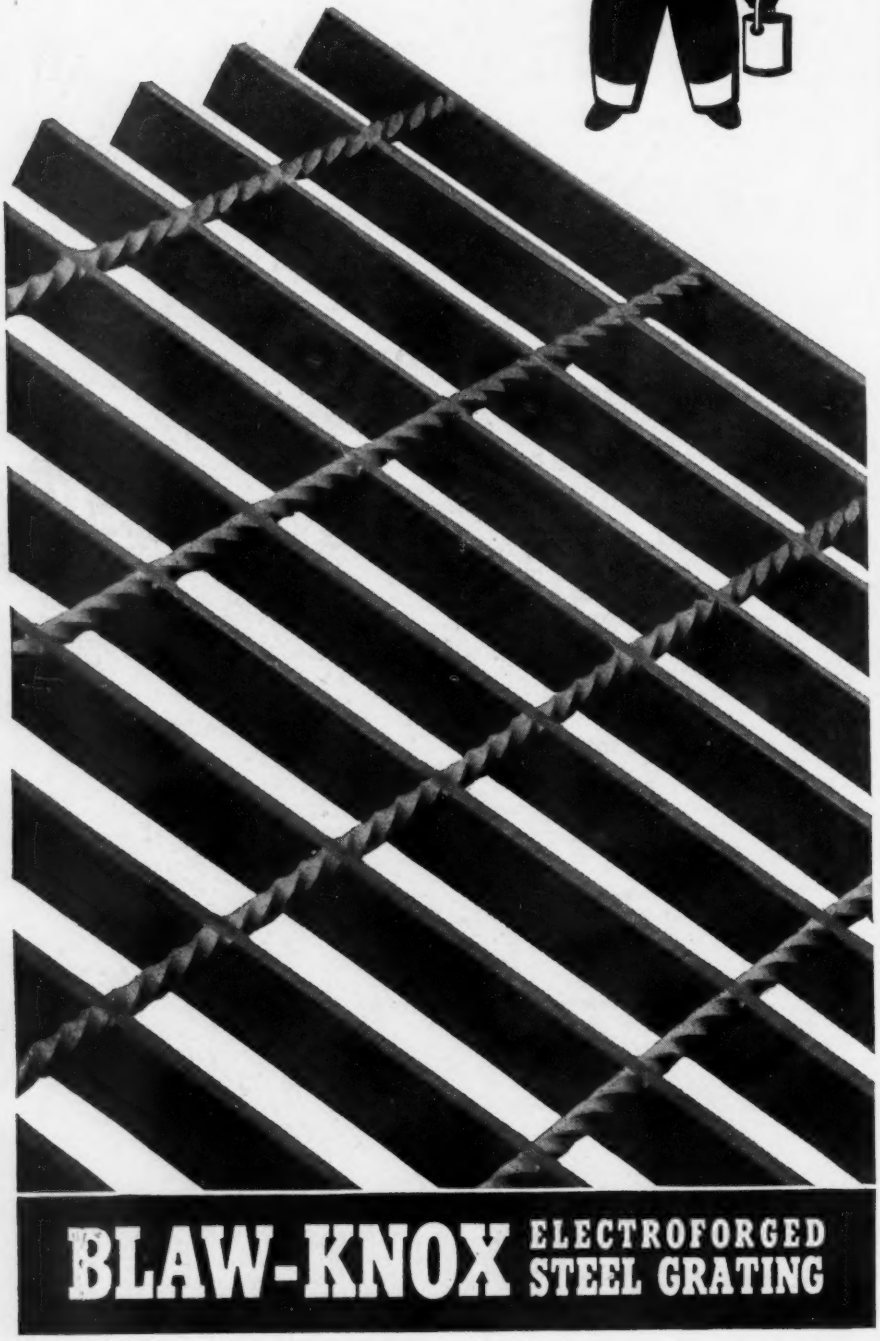
Archie T. Morrison, well known in the electrical industry and with a background of 30 years' manufacturing experience in the electrical signalling and communications field, will head up the new organization as president and treasurer. In order to protect the interests of Ark-Les customers several members of the organization have acquired a financial interest in the new project, including M. F. MacNeil, president; H. W. Batcheller, treasurer and chief en-


We build towers
of EVERY TYPE
Need transmission towers? Substations? Radio towers? Floodlight towers? Even a power windmill or memorial tower? Whatever your tower requirements, American Bridge Company has unequalled facilities and engineering experience to do the job right. It will pay you to send us your inquiries.
AMERICAN BRIDGE COMPANY
General Offices: Frick Building, Pittsburgh, Pa.
District Offices in: Baltimore · Boston · Chicago · Cincinnati · Cleveland
Denver · Detroit · Duluth · Minneapolis · New York · Philadelphia · St. Louis
Columbia Steel Company, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York
UNITED STATES STEEL
AMERICAN BRIDGE COMPANY
USS
STEEL
UNITED STATES STEEL

It is easy to penetrate every nook and corner of Blaw-Knox Grating with paint. This grating has no acute angles or hidden spaces where corrosion can easily start in the absence of a preservative outer coating.

Painting is a Cinch!

BLAW-KNOX DIVISION
OF BLAW-KNOX COMPANY
2013 FARMERS BANK BUILDING
PITTSBURGH 22, PA.



BLAW-KNOX ELECTROFORGED STEEL GRATING

gineer; G. C. Barry, general sales manager, and Bruno H. Ahlers, New York representative.

Transfer of the business into the new plant was effective January 10, without interruption in production.

•

Manufacturers Make Sales Assignments

Electrical manufacturing companies have recently made the following appointments to their sales staffs:

SIMPLEX WIRE & CABLE CO., Cambridge, Mass., has appointed W. W. Lancaster as sales representative in the New Orleans area. Mr. Lancaster will represent Simplex in the states of Mississippi, Louisiana, Arkansas, and western Tennessee, under the supervision of A. K. Felix, southern district manager.

LINCOLN ELECTRIC CO., Cleveland, has appointed R. W. Sharp district manager and sales engineer of its new Indianapolis, Ind., office with headquarters at 3343 Central Ave. Mr. Sharp was associated with Lincoln before entering military service.

GENERAL ELECTRIC LAMP DEPARTMENT has announced the retirement of T. W. Moore, for many years manager of the southeastern sales district with headquarters in Atlanta, and for more than 46 years with the G.E. organization. Southeastern sales district has been divided into two districts. One is called Carolinas Sales district, with headquarters in Charlotte, N. C., and the other goes by the former name of southeastern sales district, headquarters remaining in Atlanta. Named to manage the new Carolinas district is Glenn E. Park, who has been connected with G.E. since 1919. L. J. Campbell, who was formerly assistant district manager under Mr. Moore, has been appointed manager of the new southeastern district.

WESTINGHOUSE ELECTRIC CORP., B. F. Sturtevant Co. Division, has named Eugene N. Foss, 2nd, as manager of the company's northwestern district, succeeding Fred Herlan, retired. In his new position, Mr. Foss, who will have his headquarters in Chicago, will direct sale of Sturtevant air-handling and air-conditioning equipment in northern Illinois and Indiana, western Ohio, parts of Michigan, South Dakota and Montana, and all of Wisconsin, Iowa, Minnesota, Nebraska and North Dakota.

•

Price of Lead Advanced

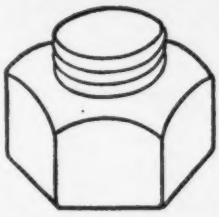
Under the impetus of the recently announced action in Great Britain, by which the British Ministry of Supply set the official selling price in Great Britain at £70 a long ton, the domestic lead price rose to 13 cents a pound, New York basis. The previous New York quotation was 12.55 cents per pound. Action, taken by the American Smelting & Refining Co., was followed by the St. Joseph Lead Co.'s advancing the price at St. Louis to 12.80 cents from 12.35 cents.

Wherever Bolted Assemblies Must Stay Tight

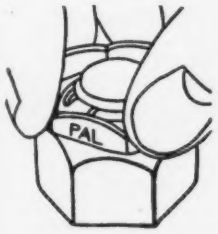
Rely on Double Locking

PALNUT LOCKNUTS

—and save cost, too!



THIS ORDINARY ASSEMBLY, consisting of bolt and regular nut, can be kept absolutely tight in service

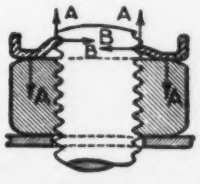


. . . WITH THE ADDITION OF A PALNUT, which spins on easily on top of regular nut and

. . . BECOMES A VIBRATION - PROOF ASSEMBLY when the Palnut is tightened with 1/3 turn of a wrench. Double-locking action* keeps bolt and nut secure.

***Double-locking action**

Arched, slotted jaws grip the bolt like a chuck (B-B), while spring tension is exerted upward on the bolt threads and downward on the regular nut (A-A), securely locking both.

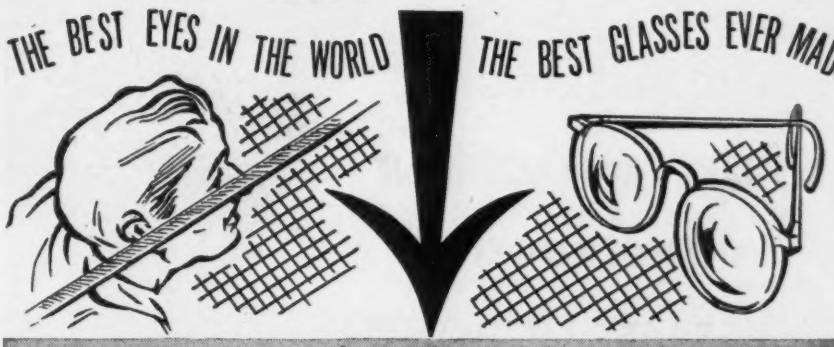


● Palnuts are available in full range of sizes, in plain, parkerized, cadmium and hot dip galvanized finishes. Send for samples and literature.

The PALNUT Co.

51 CORDIER ST., IRVINGTON 11, N. J.

THE BEST EYES IN THE WORLD THE BEST GLASSES EVER MADE



. . . are not good enough to detect tension and sag to TODAY'S standards!

Be CERTAIN with a Dillon DYNAMOMETER

Quickly gives you exact readings. Takes out all guessing. SAVES TIME. Saves maintenance. Up-to-the-minute telephone men are using Dillon Dynamometers for guys, conductor, strand or high tension wire. Large easily read figures in pounds, instantly read. No charts. No figuring. Compact, easily carried. Nine capacities for 500 to 20,000 lbs., all same size.

Weight: 8 lbs., 4oz. Size 8¼" x 6¼" x 3". Not injured by overload. Strong construction cased for all weathers

Wire, write or phone for illustrated folder with full details.

W. C. DILLON & CO. Inc.

5410 W. Harrison St., Chicago, Ill.

Parsons Light Duty Truck Body

A WORKSHOP ON WHEELS!

LOW PRICED!

Designed to provide installation and maintenance crews with everything needed to do the job . . . on the job

HERE'S efficiency because these bodies are designed for emergencies where speed is important. Side compartments for tools, replacement parts, etc. All-steel welded construction—sturdy — dependable — *inexpensive*—Model 163 for ½ ton chassis.

***Write for* Descriptive Bulletin Today!**

Parsons CREATIVE ENGINEERS MANUFACTURERS

ENGINEERING CORP.

2548 EAST 79th ST. • CLEVELAND 4, OHIO

ENGINEERING

UTILITY MANAGEMENT

CONSTRUCTION

STREET LIGHTING
MAINTENANCE

consultants on all phases
of utility operation

WELSBACH

ENGINEERING AND MANAGEMENT CORPORATION

1500 WALNUT ST., PHILA. 2, PA.

KEES
Outdoor Meter
Boxes

A size for every need.

Galvanized steel, baked aluminum finish. Designed for economical installation.

Write for catalog

F. D. Kees Mfg. Co.
Box 147
Beatrice, Nebr.

METER JEWELS
AND PIVOTS

FROM STOCK

Complete inspection service to meet your particular requirements.

JOHN J. DORLEY JEWEL CO.

Waltham 54 Massachusetts

ELECTRITE

A high grade fibre board for electrical insulation. A material of quality possessing high tensile and dielectric strength. Used by many of the leading manufacturers of electrical equipment.

DENSITE

An extremely hard board of superior quality which can replace the more expensive types of insulating materials.

Pulp Products Department

WEST VIRGINIA PULP & PAPER COMPANY

230 Park Ave., New York 17, N. Y. 35 E. Wacker Drive, Chicago 1, Ill.

Announcing—

The latest data on
BASIC RADAR
CIRCUITS

Prepared by the radar specialists of the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Now — with this single reference manual — you can quickly bring yourself abreast of latest developments in radar. It is the first complete and up-to-date volume published in this important new field—covering the subject for all engineers and physicists who are concerned with electronic applications. Reflecting the broad experience of M. I. T. radar specialists, this book deals with pulse circuits and high-frequency devices common to nearly all radar equipment. The lucid explanations of circuit operation are based on physical concepts and make free use of numerical examples.

PRINCIPLES OF
RADAR

Just Out
NEW
2nd
Edition

By members of the staff of the Radar School, Massachusetts Institute of Technology. 960 pages, 6 x 9, profusely illustrated $5.00

Originally this book was prepared to give a sound, rapid grounding in radar principles and their wartime applications. Now, in view of the many advances of the past few years, the book has been fully revised and brought up-to-date—so that it will be helpful not only to those interested in radar but also to those concerned with ultra-high frequencies and microwaves, television, pulse-time communication systems, or pulse navigation systems. This new edition begins with a brief description of the components and functions of radar systems and continues with detailed discussion of typical system components. Expositions of circuits and devices provide an unusual combination of technically thorough and accurate treatments with minimum dependence upon mathematics. Emphasis in the discussions of circuits is on quantitative analysis directly from tube characteristics and physical principles.

Supplies timely data on:

- Timing Circuits
- Indicators
- Receivers
- Magnetrons
- Modulators
- Triode Transmitters
- Radio-frequency Lines
- Radar Antennas and Propagation
- Wave Guides and Cavity Resonators
- Transmit-receive Devices
- Synchros and Servomechanisms

Mail coupon for

10 DAYS' FREE EXAMINATION

McGRAW-HILL BOOK CO.,
330 W. 42nd St., New York 18

Send me M.I.T. Radar School-Principles of Radar for 10 days' examination on approval. In 10 days I will send $5.00 plus few cents postage or return book postpaid. (Postage paid on cash orders.)

Name .....

Address .....

City and State .....

Company .....

Position .....FW 1-18-47

For Canadian price write Embassy Book Co., 12 Richmond St. E., Toronto 1

Recent Rate Changes

BUFFALO NIAGARA ELECTRIC CORP. has been authorized by the New York State Public Service Commission to revise its rate schedules covering electric service to residential consumers in a portion of its territory including 11 counties in the western part of the state. The revisions, according to the company's calculations, will result in a reduction estimated at $606,000 upon an annual basis to 66,000 of the utility's customers. The new rates became effective January 1. Under the filing the reduction will apply to the area formerly served by the Niagara, Lockport & Ontario Power Co. and by the Lockport and Newfane Power & Water Supply Co. in Allegany, Cattaraugus, Chautauqua, Erie, Genessee, Livingston, Monroe, Niagara, Ontario, Orleans and Wyoming counties. These two companies were consolidated with Buffalo Niagara Electric Corp. in 1945 and the present filings are designed to bring the residential rates in that territory in conformity with the schedules of Buffalo Niagara in the City of Buffalo. The principal change will be a reduction in the minimum monthly charge in the area outside of Buffalo from the present 90 cents to 70 cents per month, with an allowance of 14 kw.-hr. of electricity in the minimum charge, the same as in Buffalo. Reductions also are made in the consumption blocks beyond the minimum charge to conform to the rate level in Buffalo.

CONSOLIDATED GAS ELECTRIC LIGHT & POWER CO. of Baltimore has been ordered by the Maryland Public Service Commission to reduce its electric rates $3,659,000. At the same time the commission approved increases in gas and steam rates of $2,500,000 and $150,000 respectively. The commission action means an over-all net reduction of $1,000,000 in annual payments to the local utility company. A further reduction in electric rates, the commission pointed out, may result from the Federal Power Commission's recent directive decreasing, as of Jan. 1, 1947, the wholesale rate the company pays for hydro-electric power supplied by the Safe Harbor Water Power Corp. The company was directed to submit amended schedules of charges for new electric rates to effect the $3,650,000 cut. Until that has been done it will not be feasible to give data showing the effect of such reductions on the individual bills of residential, commercial and industrial customers. The new rates will become effective with the April, 1947, meter readings.

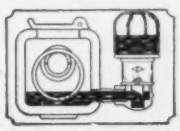
TIDE WATER POWER CO. has announced reductions in electric rates, which will effect a saving of approximately $60,000 annually for 20,000 customers in 13 southeastern North Carolina counties. The reduction was ordered by the North Carolina Utilities Commission in accordance with a plan submitted by Tide Water to reduce the rates in the counties of Bladen, Brunswick, Columbus, Duplin, Pender, Carteret, Craven, Greene, Jones, Lenoir, Onslow, Pamlico and Wayne. New rates, according to utility officials, will make the rates in the 13 counties conform to existing rates in New Hanover County. In March, the company reduced rates in New Hanover by approximately $108,000 annually upon orders of the commission.

CALIFORNIA-PACIFIC UTILITIES CO. has been ordered by the state Public Utilities Commission to reduce its electric rates to consumers in Susanville, Chester and Honey

GUARD BEARINGS
with
TRICO OILERS!

OPTO-MATIC OILERS

- Maintain an accurate level of oil in ring and ball bearings, gear and pump housings, etc.
- Eliminate bearing failures and guesswork of trust-to-luck hand oiling.
- Improve appearance and efficiency of any machine.



As oil is consumed, the OPTO-MATIC Feeds new oil instantly and positively. No guesswork—no hazards. Oil supply is always visible.

KLIPLOK CLAMPS

Lock fuses and clips together. Eliminate burnt fuses, unnecessary shutdowns and wasted current.

Write for Catalog on Constant Level, Gravity, Wick, Thermal, and Bottle Oilers. There's a style for every application!

TRICO

WRITE for Bulletin #6

TRICO FUSE MFG. CO. Milwaukee, Wis.

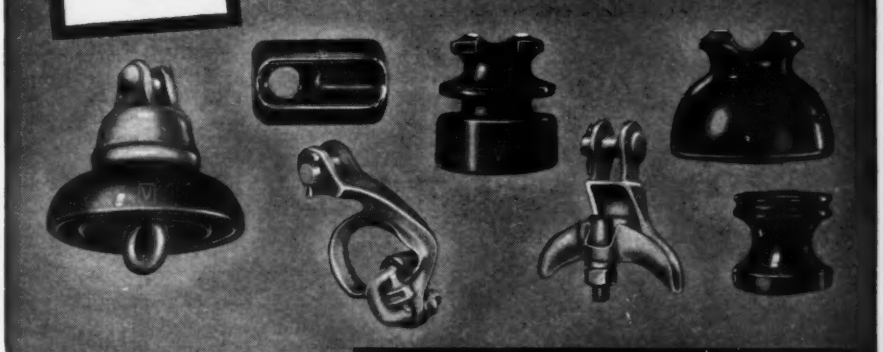
Specified ON IMPORTANT INSTALLATIONS···

Impressed on Each Piece of Victor Porcelain THIS SYMBOL OF QUALITY

V

• High tension porcelain insulators made at Victor have passed the most severe tests on various types of installations during the past 50 years. For safety, long service and satisfaction in high voltage insulators, look to Victor.

THE MARK OF ENDURING SERVICE



BIRTHPLACE OF FIRST WET PROCESS HIGH-VOLTAGE INSULATORS

VICTOR INSULATORS, Inc.
VICTOR, NEW YORK

COHARDITE
INSULATED TOOLS

Reduce accidents and service interruptions

No. 60 Hacksaw Frame

List Price $11.25

Strong, light weight steel frame, heat treated and tempered to prevent set. Takes any standard 12" blade. COHARDITE insulation solidly molded on the frame and tested to 20,000 volts R.M.S. Shape of frame makes it particularly valuable for underground work or in other confined spaces.

Every tool tested to its full rated dielectric strength for one minute R.M.S. before it leaves our plant.

A full range of COHARDITE insulated small tools carried in stock for Meter and Distribution Departments.

Send for CATALOG

The Connecticut Hard Rubber Co.
62 East Street, New Haven, Conn.

Flexible!

It's a long cry from the days of long ago, when wire was pounded out by hand to the Controlled Flexibility of wire and cable we make today at Flexo Wire Company.

We at Flexo, have the most modern of wire machines, and years of engineering background. And as a result we have made it our work to specialize in special jobs—"Tailor Made" wire for your particular need.

Write in today and tell us your wire problem and ask for a copy of the Flexo Wire Catalog #62.

Flexo Wire Company
70 W FIRST STREET OSWEGO, N. Y.

Lake Valley in Lassen and Plumas counties. The reduction, which was effective January 2, will bring an annual savings of about $38,900 to consumers. The cuts average about 20 percent for domestic users and 15 percent for commercial users in Susanville and Honey Lake Valley, and 8.3 and 5.6 percent for Chester.

OHIO PUBLIC SERVICE CO. has reduced its charges to domestic consumers at Warren, Ohio, between $37,000 and $40,000 a year under the terms of a new rate ordinance.

MOUNTAIN STATES POWER CO. new rate schedules, reducing power rates more than $20,000 annually, have been approved by the Idaho Public Utilities Commission. The utility, which serves north Idaho counties, set up new rates reducing residential rates by $11,595 a year, and commercial rates, $9,279 a year, effective January 1.

CLEARWATER VALLEY LIGHT & POWER ASSN., INC., Lewiston, Idaho, has announced new rate schedules, effective January 1. The new schedules are: (1) Farm and home service—first 50 kw.-hr. per month, 6 cents per kw.-hr.; next 50 kw.-hr., 3 cents per kw.-hr.; next 100, 2 cents per kw.-hr.; next 100, 1 cent per kw.-hr.; over 300 kw.-hr. per month, ¾ cents per kw.-hr. The minimum monthly charge is $2 where 3 kva. or less of transformer capacity is required. For more than 3 kva. transformer capacity, the minimum monthly charge is increased 75 cents for each additional kva. or fraction thereof required. (2) Schools, churches and community halls—schedule is the same as that for commercial and industrial lighting and power service, except that there is not minimum annual charge of $24 where 3 kva. or less of transformer capacity is required. For consumers requiring more than 3 kva. of transformer capacity, the minimum annual charge is increased at the rate of $9 for each additional kva. or fraction thereof required. (3) Service in rural villages—residential members in rural villages are served under terms of the farm and home service schedule, except that the minimum monthly charge is $1.50.

•

Manufacturers Issue Earnings Reports

Among the electrical manufacturing companies which have recently issued statements of earnings are the following:

FORMICA INSULATION—Nine months, net income, $220,875 or $1.35 a share, against $240,361 or $1.47 a share, 1945.

SQUARE D—Nine months, net profit, $1,518,228, or $1.10 a common share, compared with $1,183,452, or 86 cents, 1945. Earnings in both periods are based on 1,377,480 shares now outstanding. Common was split three for one on April 23, 1946.

CORNELL-DUBILIER ELECTRIC—Net sales of $15,524,518 for fiscal year ended September 30, 1946, 99 percent of which represented civilian business, compares with $19,851,745 for year ended September 30, 1945, when the company was engaged chiefly in war work. Sales during the twelve months ended September 30, 1941, the last preceding fiscal year in which business was predominantly civilian, totaled $6,416,506.

ILSCO
IS READY FOR '47

• • •

ELECTRICAL LUGS AND CONNECTORS

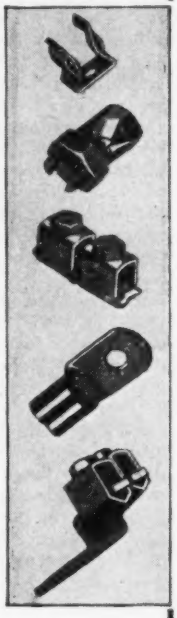
Economical . . . dependable . . . precision engineered for 100% satisfactory service.

FABRICATED TUBE PARTS

Standard or items for your special purposes.

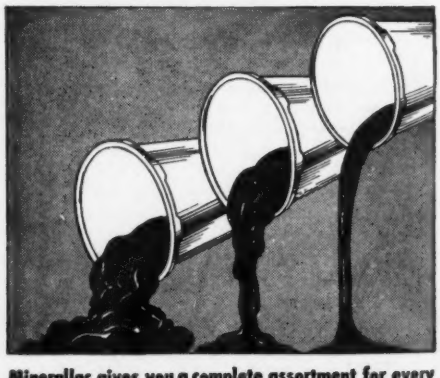
UNDERWRITERS AND CANADIAN APPROVED

WRITE TODAY for 48-page illustrated catalog.



ILSCO COPPER TUBE & PRODUCTS, Inc.
CINCINNATI, OHIO

Insulating and Cable-Pulling
COMPOUNDS
of Record-Breaking Performance



Minerallac gives you a complete assortment for every need: dense, viscous and fluid consistencies for high and low voltages in cable-joints, pot-heads, terminal bills, distribution cables, street lighting, telephone work. . . . Insoluble in oil or water, for all temperatures. Clean, safe, economical—outranks all others in quality.

Send for new literature and prices.

MINERALLAC ELECTRIC COMPANY
25 North Peoria Street—Chicago 7, Illinois

MINERALLAC

Electricity in

GREATER HARTFORD

gives everyone—
Homes, Industry
and Business—
Good Service at
Low Cost.

★

The services of
Technicians of
This Company
are available
to make power
a more useful
Servant for All.

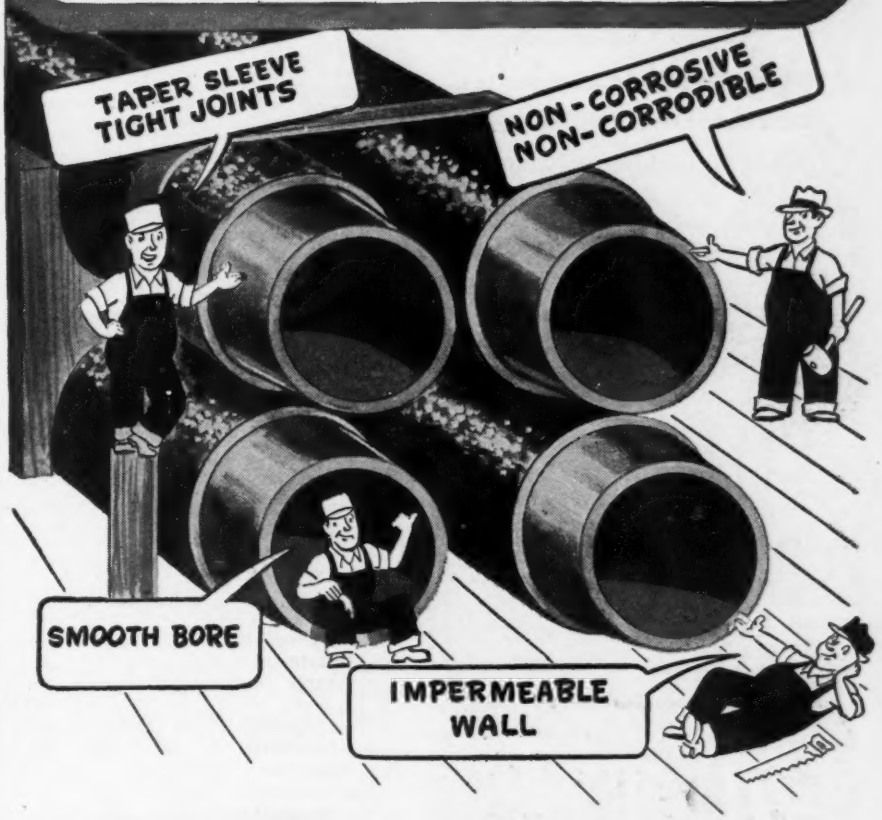
★

Our war-time
experience in doing
The "Impossible"
will serve you
efficiently in
Peacetime.

★

THE HARTFORD
ELECTRIC LIGHT CO.

GUARDING THE LIFELINE
with 4-way protection!



Cable is the lifeline of power and communications systems. Give it this vital 4-way protection with ORANGEBURG* CONDUIT . . . .

1. **Protection** from cable sheath abrasion . . . because of its smooth bore, ORANGEBURG reduces the danger of damage to the sheath when cable is pulled into duct.

2. **Protection** from pulling tension . . . because the friction coefficient is lower in ORANGEBURG than in ducts made of other materials, lessening strains caused by cable pulling tension.

3. **Protection** from water infiltration . . . because ORANGEBURG'S impermeable wall gives cables maximum safety from ground water and resulting corrosion.

4. **Protection** with cable movement . . . because the smooth surface of ORANGEBURG reduces wear on the sheath as the cable expands and contracts with changing loads. *Write for the Catalog today.*

THE FIBRE CONDUIT COMPANY • ORANGEBURG, N. Y.
Graybar Electric Co., Inc. • *Distributors* • General Electric Supply Corp.

*Reg. U.S. Pat. Off.

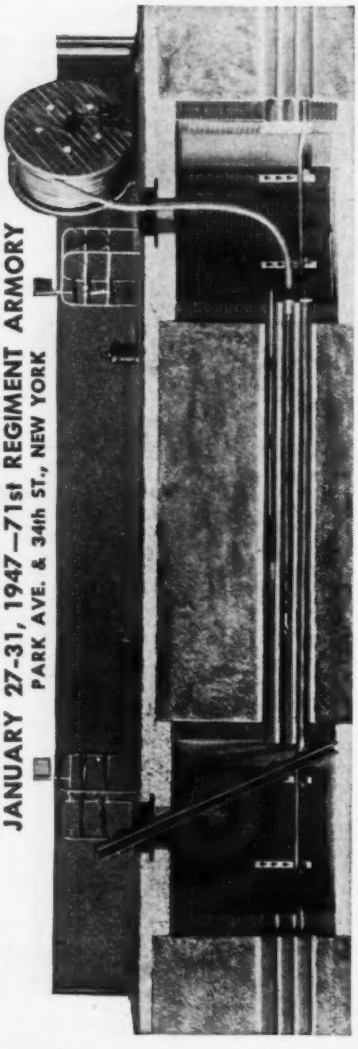
THE FIBRE CONDUIT CO. REG. U.S. PAT. OFF. ORANGEBURG N.Y.

ORANGEBURG

WITH 50 YEARS EXPERIENCE IN THE MANUFACTURE OF NON-METALLIC CONDUIT AND PIPE, SERVES THE POWER AND LIGHT, TELEPHONE, GENERAL CONSTRUCTION, CHEMICAL, PETROLEUM, PLUMBING AND BUILDING SUPPLY FIELDS WITH ELECTRICAL FIBRE CONDUIT . . . ELECTRICAL UNDERFLOOR DUCT SYSTEMS . . . AND FIBRE PIPE FOR NON-PRESSURE USES.

"Cope"

Pioneers of many features in cable installation equipment that today have become standard in almost all of the principal telephone companies, central stations, and municipal plants throughout the country.



VISIT OUR BOOTH NO. 10 AT THE
ELECTRICAL ENGINEERING EXPOSITION
JANUARY 27-31, 1947—71st REGIMENT ARMORY
PARK AVE. & 34th ST., NEW YORK

T. J. Cope Inc.
6120 Vine Street,
Philadelphia 39, Pa.

TOOLS AND EQUIPMENT
FOR THE INSTALLATION
AND MAINTENANCE OF CABLE
FOR OVER FIFTY YEARS

(*Continued from page* 129)

caster, Ohio, but the co-op steadfastly refused to recognize the union. An employees' appeal to NLRB failed when the board held that it had no jurisdiction in the case. Directors of the South Kentucky Rural Electric Cooperative Corporation, with headquarters at Somerset, also opposed a union of its outside workers until the U. S. Conciliation Service and union arbitrators finally worked out a settlement. Incidentally, workers of this co-op staged another walk-out last August, forcing the rehiring of a system manager dismissed by the directors.

NLRB remained aloof from co-op labor disputes until September, 1944, when it settled a strike of the Gibson County Electric Membership Corporation at Trenton, Tenn., in favor of I.B.E.W. workers. The board took jurisdiction on grounds that the co-op supplied electric power to industries engaged in interstate commerce. It has been entering co-op labor disputes ever since.

One policy decision of NLRB gave pause to plans of some co-ops to buy out established power systems. This ruling obliged a cooperative to assume union contracts of any acquired system when such contracts had been negotiated through NLRB or the War Labor Board. Since a Maryland co-op took over a small distribution system manned by union workers and found it necessary to negotiate with those workers, other co-ops have been careful to inquire about labor contracts before becoming involved in acquisition proceedings.

Co-op Manager Forced Out

Another recent strike, involving the Crawford Electric Cooperative, Inc., of Bourbon, Mo., ended only with the resignation of the co-op manager, who had been accused of discrimination by I.B.E.W. employees.

Few strikes of co-op workers have resulted in lengthy interruptions of service. According to REA and union records, the power shutdowns experienced by customers of South Central Rural Electric and of the Firelands Electric Cooperative, Inc., both in Ohio, caused the most serious damage. In most other walkouts, service was maintained by non-union or supervisory personnel.

Labor troubles have not affected a great majority of REA co-ops, largely because of the size of their staffs. For the average small distribution cooperative, purchasing its power from an unaffiliated generating plant, a staff of one or two men, including the system manager, generally is sufficient to maintain service. When major systems extensions are required, the co-op en-

Find the answers you need—in these 4 McGRAW-HILL Books

See one or all 10 days on approval

TRANSMISSION LINES
Design, Construction and Performance

By **FRED C. DEWEESE**, General Engineer, Carolina Power and Light Company. **297 pages, 5¼x8, 182 illustrations and tables, $3.50.**

Deals exclusively with the design, construction, and day-in, day-out performance of high-voltage transmission lines. An authoritative, easy-to-follow guide to transmission line work, the book presents step-by-step procedures from simple short-line problems through long high-voltage line problems requiring involved mathematics for their solution.

BASIC ELECTRICAL ENGINEERING
Circuits, Machines, Electronics

By **A. E. FITZGERALD**, Associate Professor of Electrical Engineering, Massachusetts Institute of Technology. **443 pages, 5¾x8¾, 383 illustrations, $3.75.**

Direct and fundamental treatment of electrical engineering, presenting an integrated view of circuit theory, electrical-machinery fundamentals and applications, and engineering electronics. Gives the reader a rapid grasp of working fundamentals from simplest circuit concepts to instrumentation and automatic-control application in research and industry.

AMERICAN ELECTRICIAN'S HANDBOOK
A Reference Book for Practical Electrical Workers

By **TERRELL CROFT**, Consulting Electrical Engineer. Revised by Clifford C. Carr, Head of Electrical Engineering Department, Pratt Institute. **Fifth Edition. 1600 pages, 5x7½, 1177 illustrations, 64 tables, $5.00.**

This book is packed from cover to cover with the facts which every man engaged in electrical work needs to have constantly at hand. From clear explanations of the fundamentals of electricity, to suggestions for remedying the troubles of electrical equipment, the information is the kind that helps practical electrical men select and install commercial electrical apparatus and materials intelligently for the performance of specific services, operate electrical equipment efficiently, and maintain it at high operating efficiency.

SEND THIS McGRAW-HILL COUPON
for copies 10 days' on approval

McGraw-Hill Book Co., 330 W. 42 St., N.Y.C. 18
Send me the books checked below for 10 days' examination on approval. In 10 days I will pay for books, plus few cents postage, or return books postpaid. (Postage paid on cash orders.)

- ☐ **DeWeese—Transmission Lines, $3.50**
- ☐ **Fitzgerald—Basic Electrical Engineering, $3.75**
- ☐ **Croft—American Electrician's Handbook, $5.00**

Name .....
Address .....
City and State .....
Company .....
Position .....W. 1-18-47
For Canadian prices, write Embassy Book Co., 12 Richmond St. E., Toronto 1.

BLAW-KNOX
TRANSMISSION TOWERS

BLAW-KNOX DIVISION
of Blaw-Knox Company
2013 Farmers Bank Building
Pittsburgh, Pa.

gages a construction crew, either directly or through a contractor.

These factors were not so apparent in 1941 when I.B.E.W. opened an organizing drive among cooperative employees. Encouraged by its successes in negotiations at such projects as the Tennessee Valley Authority, the Bonneville Power Administration and Boulder Dam, the union advised its organizers that, "in a sense," the REA systems belonged "to the public power branch of the electrical industry" and constituted a field which "must be serviced by the I.B.E.W."

Together with REA officials, the union worked out a "framework of operation," in accordance with which the organizing drive was conducted. This agreement recognized that the co-ops generally could not meet wage standards prevailing among large utilities. It classified the cooperatives in three groups: (1) Generating and transmission co-ops serving five or more rural co-ops, to pay the prevailing I.B.E.W. wage scale; (2) Well-established local co-ops serving an average of at least four consumer members per mile of line, to pay wages roughly 10 percent lower than the rate prevailing in the nearest city with an I.B.E.W. union; (3) Small co-ops serving less than four consumers per mile, to pay "a negotiated wage."

REA Suggests Labor Standards

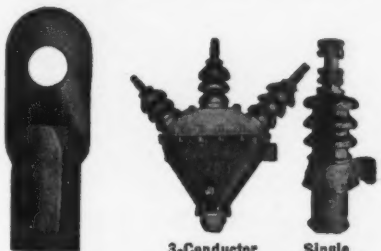
The agreement also pledged the union to "utilize all its machinery of organization" to avoid strikes on co-op lines. REA agreed to "promulgate a list of labor standards" and endeavor to win "REA cooperatives to the acceptance" of such standards.

REA urged its borrowers to accept unionization and set up an advisory section to assist co-ops in labor negotiations. This service has been largely educational, according to REA officials, since the agency has no authority to map labor policies for individual co-ops. These officials admit that, by and large, the co-ops still are strongly opposed to unionization.

Apparently, I.B.E.W. has come to about the same conclusion. National officers in Washington hint that the union now is more interested in other projects and that the push behind its co-op drive has slacked off.

Less than 10 percent of the 800-odd rural electric co-ops are unionized. Forty have what the union terms "active contracts" with I.B.E.W. Only one, the Top-O'Michigan Rural Electric Company of Boyne City, has a contract with the Utility Workers Union of America, further evidence of the farmer's distrust of the C.I.O. A few more co-ops have recognized independent unions.

ELECTRICAL SPECIALTIES
FOR HEAVY INDUSTRIAL SERVICE
RMC
FROM STOCK



Write for a complete selection of RUSGREEN bulletins

ENDULATORS (POTHEADS) ALL SIZES • ALL SHAPES • ALL VOLTAGES • ALL TYPES • BUS SUPPORTS • SPLICING KITS AND MATERIALS • INSULATING COMPOUNDS

★ ★ ★

RUSGREEN MFG. CO.
14260 Birwood Avenue • Detroit, Mich.

ALL the strength and durability inherent in steel are combined—with definite economies—in *Crapo* Galvanized Steel Strand. Heavy, ductile, tightly-bonded zinc coatings, applied by the famous *Crapo* Galvanizing Process, provide lasting protection against corrosion.

Ask the distributor of *Crapo* Galvanized Products near you or write direct for further information!

INDIANA STEEL & WIRE CO.
MUNCIE, INDIANA

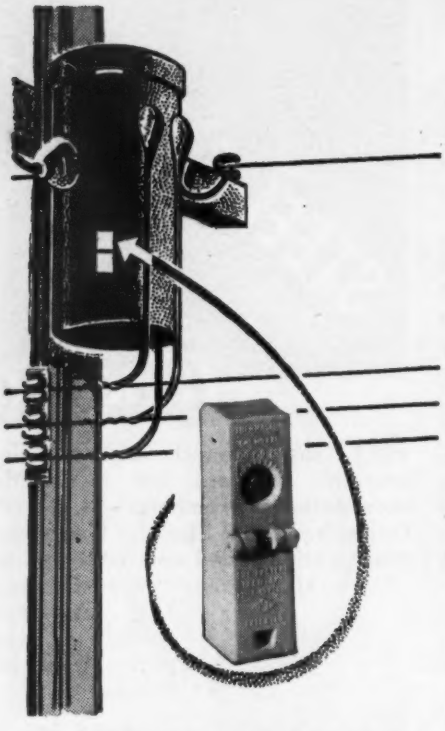
DOSSERT CONNECTORS

A heavy duty stud connector for connecting a tubular bus, cable or solid rod conductor to a threaded or plain transformer stud.

For complete listing of POWER connectors send for Catalog 45

DOSSERT MANUFACTURING CORP.
249-254 Huron St. Brooklyn, N. Y.

SUBALOX
LEAD AND ALUMINUM PAINT
Spot or Full Coat
for
Galvanized Structures.
It sticks, it blends.
SUBOX INC.
NORTH ARLINGTON, N. J.

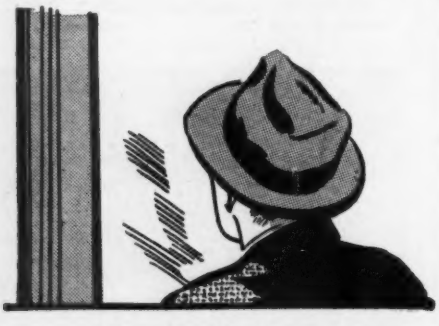


TRANSFORMER
TOO HOT!
SAYS THE
THERMALARM

And when transformer temperature is too high, there's danger!

THERMALARM, a small unit easily attached to transformers, tells you the load condition of your transformers at a glance and lets you know if there is danger. THERMALARM flashes a bright red color when the transformer temperature soars. The red flag can easily be seen by cruising inspectors, who learn at a glance of anything is wrong!

THERMALARM is easily attached to your transformer with special adhesive cement supplied with each unit. It's inexpensive—only $3—and will be valuable to your distribution system and save you many dollars. Mail your order today for as many THERMALARM's as you need at the low cost of $3 each.



EASTERN
SPECIALTY CO.
3617 N. 8th St. Philadelphia 40, Pa.

LETTERS TO THE EDITOR

Self-Excited Alternators

To the Editor of ELECTRICAL WORLD:

Your recent editorial, "A Self-Excited Alternator," in the December 7, 1946, issue of ELECTRICAL WORLD particularly attracted my attention because self excitation, and particularly self excitation to inherently provide automatic voltage regulation, has long been a topic of prime interest to us.

The recently developed "Regulectric" generator is not self-excited, but the novel regulatory system accomplishes, without moving parts, the "compounding," for self regulation, that is so desirable.

Although now applied to the smaller a.c. generators, it is expected that the Regulectric circuit will be utilized with generators of increasing size.

S. P. Bordeau
Mgr., Advertising & Technical Publications Dept.
Electric Machinery Mfg. Co.
Minneapolis 13, Minn.

Oil Oxidation Tests

To the Editor of ELECTRICAL WORLD:

We have read with great interest the series of three articles in the August issues by W. G. Horsch on "Oxidation Testing of Transformer Oils." We wish to offer a correction regarding the designation and origin of the tests attributed to Switzerland in the 13th column of Table I (page 57) of the August 3, 1946, instalment. It is that the upper items in that column should read:

Common designation	SEV Method
Country of Origin	Switzerland
Author	SVMT & SEV
Adopted as Standard	Yes
Sponsoring Organization	SEV

The test conditions were correctly stated.

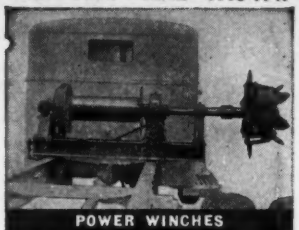
A. S. Stainder
Chief Engineer
Testing Laboratories
Swiss Association of
Electrical Engineers
Zurich, Switzerland

•

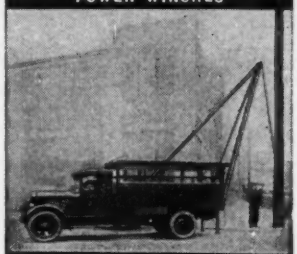
Engineers Close Office

The Tallahassee, Fla., office of the Army Engineers was closed December 6. Work formerly handled by this office will now be handled at Jacksonville, Fla., Savannah, Ga., or Mobile, Ala.

PIONEER MFRS. OF
Truck Winch & Crane Equipment
FOR PUBLIC UTILITIES
OUR 29TH YEAR—1918-1947



POWER WINCHES



TRIPOD POLE DERRICKS

WINCHES: Capstans; Single and Double Drum, Jaw Clutch, Keyed and Friction Clutch Winches, 2,000 to 50,000 lb. Cap.
POLE SETTING DERRICKS, TOWERS, CRANES, etc.
TYPICAL USERS: AT&T; N. Y. Tel. Co.; T.V.A.; Virginia P. S. Co.; Consolidated Edison Co.; Ohio Power Co.; Texas Power & Light Corp., etc.
Send for Catalog No. 60

THE ORIGINAL SWING BOOM MOBILE CRANE WITH FRONT-WHEEL DRIVE AND REAR-WHEEL STEER
2½, 5, AND 10 TON CAPACITIES
KRANE KAR
TRADE MARK REGISTERED
SILENT HOIST & CRANE CO.
862-63rd ST., BROOKLYN 20, N. Y.

TEST INSULATION
THE MODERN WAY

...WITH A
MEGOHMER
NEW NON-CRANKING TYPES

No more tiresome cranking of a hand-driven generator. Steady test potential of 500 volts D. C. instantly available at turn of switch. Direct readings of insulation resistances without calculations. Two types, Model B-5 and C-2. Ranges 0-200 megohms, and 0-100/1000 megohms with 1, 2 or 3 additional ohm scales in same instrument. *Write for Bulletin No. 435-445.*

HERMAN H. Sticht COMPANY, INC.
21 PARK PLACE NEW YORK, N. Y.